SCIENTIFIC AMERICAN SUPPLEMENT. No. 1145

Scientific American, established 1845.
Scientific American Supplement, Vol. XLIV. No. 1145.

NEW YORK, DECEMBER 11, 1897.

Scientific American Supplement, $5 a year.
Scientific American and Supplement, $7 a year.

STEAM YACHT FOR THE ENGLISH AMBASSADOR AT CONSTANTINOPLE.

MANY of our readers, says the London Engineer, will no doubt be surprised to learn that although all the ambassadors of the chief Continental powers in Constantinople have for many years had very excellent steam launches attached to their embassies, the representative of Great Britain in that city has been without one until very lately, an omission which has been owing to the want of decision as to who—the Foreign Office or the Admiralty—should bear the cost of supplying and maintaining such a vessel.

The Thames Ironworks Company has completed a steam launch, or rather yacht, for the special use of his Excellency our ambassador at Constantinople, illustrated herewith.

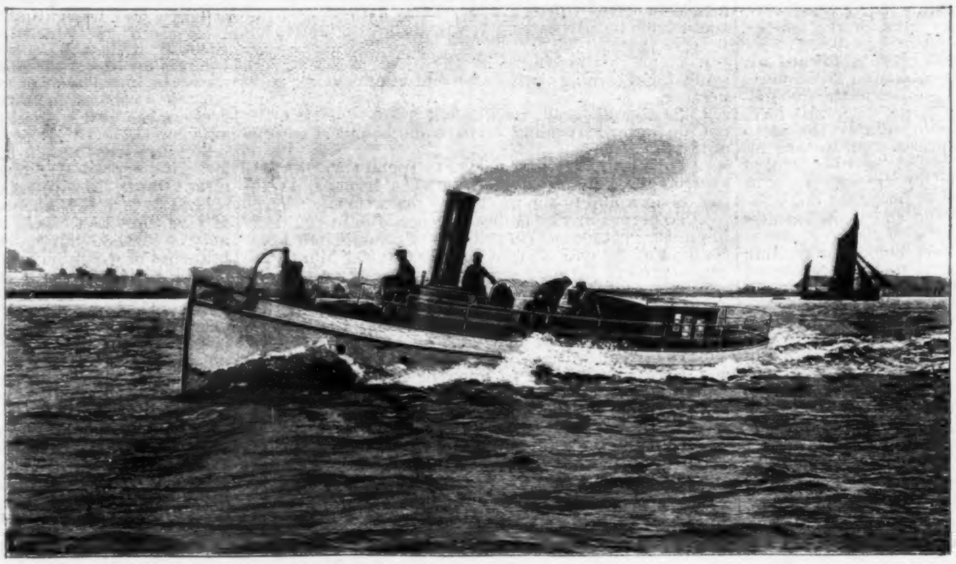
The dimensions of this vessel are: Length on the water line, 60 ft.; breadth, 10 ft. 9 in.; depth, 5 ft. 5 in.; and water draught, 3 ft. 5¼ in. forward, and 5 ft. aft. She is fitted with compound surface-condensing engines, the high pressure cylinder being 9½ in., and the low pressure one 19 in. diameter, both with a piston stroke of 10 in., driving a single screw. The engine bed plate is built up of two longitudinal steel bearers extending the whole length of the engines, to which are bolted the cross main bearing brackets, made of manganese bronze. The columns supporting the cylinders are of forged steel, braced diagonally, as shown. The air pump is driven by a small crank overhung at the end of an extension of the main crank shaft, the feed pumps being worked by a worm on this shaft gearing with a worm wheel for reducing their speed, the ratio of the gear being 3 to 1. Great care has been taken in balancing the main crank shaft, with the result that, at a speed of 500 revolutions per minute, perfect steadiness is secured, without any perceptible vibration.

The steam distribution valves are of the usual type fitted to high speed engines; that on the high pressure cylinder being a piston valve, while for the low pressure a flat double ported valve is used, with the exhaust passing through its back, thus relieving it from face pressure, and rendering it practically a balanced valve. Cooling water is supplied to the surface condenser by a centrifugal circulating pump driven by an independent engine.

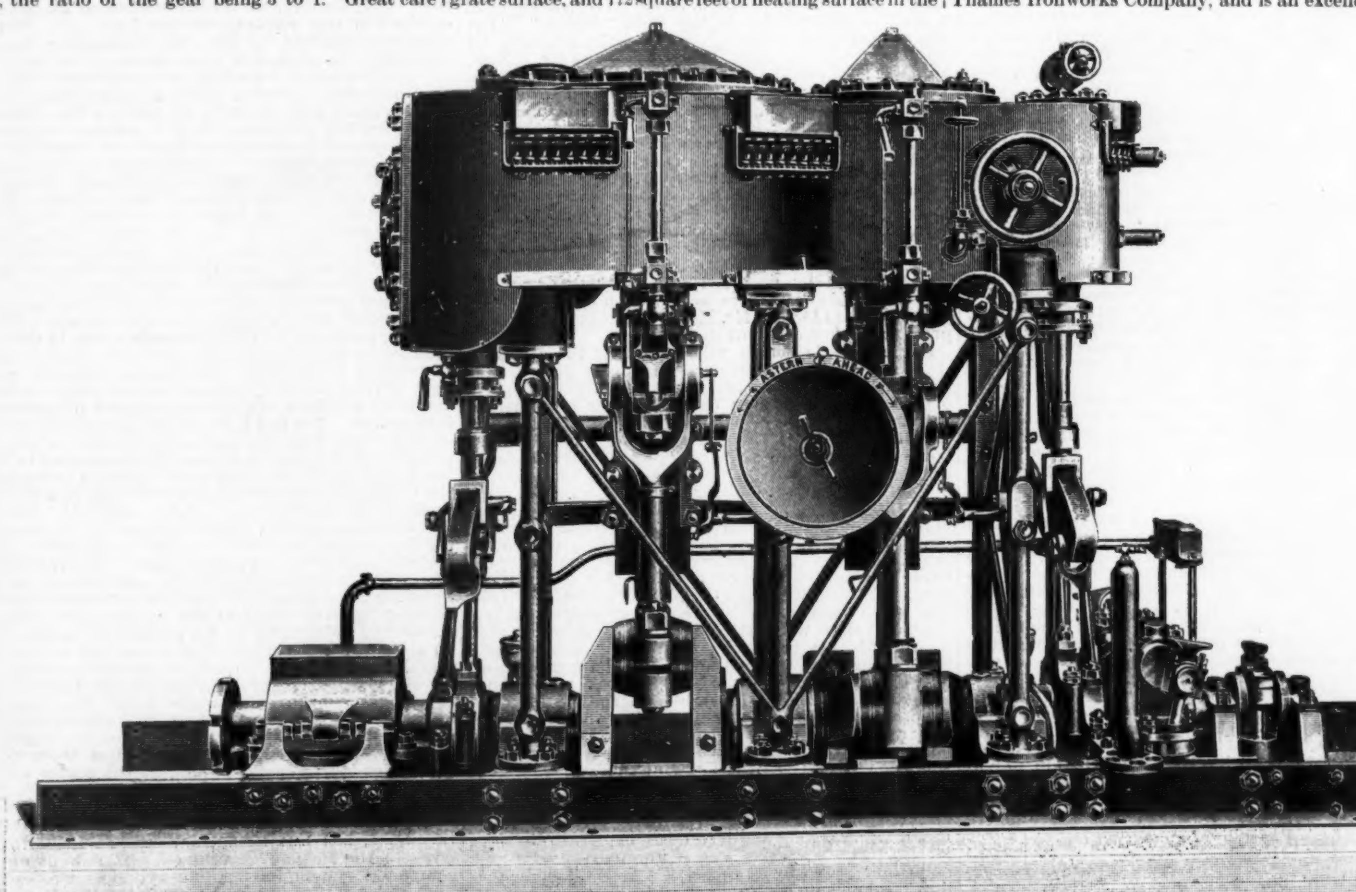
Steam for the engine is supplied by a Thames Ironworks patent water tube boiler of 18 square feet of fire grate surface, and 772 square feet of heating surface in the tubes, and like all of the similar make of boilers fitted in the Admiralty steam pinnaces made by the company, works without priming, and maintains a steady water level and steam pressure. The boiler is weighted to 185 lb. pressure per square inch at the safety valves, a forced draught at an air pressure of 4·2 in. in the stokehold being obtained by means of a fan driven by an independent engine. All Admiralty safety appliances have been introduced, thus making the machinery one of the most advanced examples of the small high speed type.

On the trial of this yacht, which took place shortly before she left the Thames for Constantinople, the mean speed realized on six measured miles, with the engines developing 361 indicated horse power, was 15·485 knots, and on a 2½ hours' continuous run 15·28 knots an hour, the mean revolutions of the engines being 512·35 per minute; the force of the wind being 2 and the sea smooth, hand picked Welsh coal being used.

As will be seen from the longitudinal section of the vessel we give in Fig. 1, there is good accommodation forward for the small crew required; and a very commodious saloon aft, with laboratory, pantry, etc., in addition to ample quarters for his Excellency the ambassador and any notables or friends to whom he may have to give audience, or meet at different times. The vessel will supply a long-felt want at Constantinople, and will bear favorable comparison with any others running on the Golden Horn. She is built of two thicknesses of teak, with waterproof canvas between them, and is copper fastened throughout. Her keel, stem, and stern post are of English oak. She was designed by Mr. G. C. Mackrow, naval architect to the Thames Ironworks Company, and is an excellent speci-



YACHT OF THE BRITISH AMBASSADOR AT CONSTANTINOPLE.



COMPOUND ENGINES FOR AMBASSADOR'S YACHT.

men of the work turned out from the Orchard Shipyard and Engineering Works, Blackwall.

AMERICAN NAVAL ENGINEERS.

As our readers are aware, the engineers of the United States Navy have not been altogether satisfied with their position and the recognition they receive for their certainly arduous services. As there is no other navy so nearly akin to our own in regard to its personnel as that of the United States, an examination of certain proposals recently put forward will be of more than vicarious interest to us. The American naval engineers have found an able spokesman in the person of Professor Ira N. Hollis, who was formerly an officer in the corps of United States Naval Engineers. This gentleman has set forth his ideas in an article which appears in a recent (September) number of the Atlantic Monthly, a magazine published in Boston, U. S. It is safe to say that the views expressed by Professor Hollis have the support of, at any rate, a large section of the corps to which he formerly belonged. It is said that the propositions set forth were submitted to the Navy Department at Washington before the article appeared and that the Secretary (Mr. Long) and Assistant Secretary (Mr. Roosevelt) of the United States Navy are both very much interested in the matter. This naturally does not mean that the scheme has official sanction, and it is, of course, impossible to say what view the United States Congress may take of the matter. The position of the line officers—who correspond to our executive officers—is not altogether cordial toward Mr. Hollis' proposals, a fact which might be anticipated from the nature both of the proposals and the line officers. A number of the latter holding high rank have written to the department protesting against the adoption of the suggested plan. Nevertheless, we are informed, some of the younger and more thoughtful of the executive branch think well of the scheme, or at any rate think reforms on the lines indicated might be advantageous to the efficiency of the United States Navy.

So much by way of preface, but before proceeding to examine Mr. Hollis' scheme it may be remarked how strange it is to find the professor, in dealing with the navy of so modern and "go-ahead" a people as the Americans, opening his article with the statement that the last few years "has marked the complete break, perhaps forever, with the old line-of-battle ship, dependent for its motion upon an unreliable element, and the adoption of the powerful hull driven by a machine whose reliability depends only upon the care and foresight of men;" in other words, the United States has now steamers in place of sailing ships for the line of battle. Now, it would hardly more enter our heads in this country to emphasize this fact than it would to state that the Household Troops are no longer armed with bows and arrows, yet we organize the personnel of the navy very much as if James Watt had never lived and we were still in the glorious old days of "Nelson, Hood and Collingwood," when ponderous three-deckers sailed leisurely into action, and then lay, yard arm to yard arm, blazing away for hours until one or other had had enough of it, or there was a chance to board and settle the matter out of hand. In frigate actions it was somewhat different; but, heroic as these generally were, they constituted only the skirmishes of the seas, and had but small influence on the fate of nations. But even if the "motive power" had played ever so important a part in the decision of sea fights, the difference between then and now is that formerly the executive officers were thoroughly masters of the whole "mystery" of the propelling agency, whereas nowadays a captain in the engine room is about as useful as a marine at the weather earring. So far as we can judge, our emancipated and non-aristocratic cousins in America are little if anything ahead of us in this matter, and perhaps Mr. Hollis does well to remind Americans that they too have a steam-driven navy.

Mr. Hollis is commendably plain spoken in dealing with his subject. "For thirty years," he says, "there has been a struggle between the line and the staff of the navy; or between those officers who may succeed to the command of ships and those who may not. This struggle has developed the greatest bitterness between the line and the engineer corps." He goes on to point out that "the men in the compartments containing guns and ammunition and the men in the engine and boiler rooms must stay." They are both essential. "They belong to the fighting machine." It is further of paramount importance that "they must work in entire harmony toward the same ends," not only that they may live in peace among themselves, which is most desirable, but also "to attain the highest qualities of the ship." It is apparently in the American Navy, as in the English service, that "questions between the line and the engineers are carefully avoided at well regulated mess tables;" but it will be seen that such questions exist, and are of a very burning nature. Mr. Hollis compares the situation to being "penned up in the crater of a volcano," and attributes to this cause the reason of many graduates of the naval academy having left the service.

The situation is not so acute as this in the British Navy, but the conditions are somewhat different in regard to the national character and aspirations. In the United States the line and staff are brought up together until they enter the service, being graduates of the same school. There is no quarrel so bitter as the quarrel between brothers, and so it is that a sentiment of equality having been planted during the period of pupilage, it is very difficult for one branch to give way to the other in regard to accepting a position in which it must always receive and not give orders. This is the chief circumstance in which the training of the personnel in the navies of the two nations differ. With us the executive and engine branches are educated apart. Keyham never thinks it has the same function to perform as Dartmouth, and both branches enter the navy with a well defined status, which, in itself, is a great protector of harmony. Under existing conditions of service we prefer the English plan.

Mr. Hollis would put an end to the undesirable state of affairs in the United States Navy by the often suggested plan of fusion. "The only solution of the matter lies in fusing together the line and the engineers, and in making them all the line, except a small number, selected for technical attainment in engineering, to do the duties of chief engineers on board and on shore. All officers except the chief engineer, surgeon and paymaster would then be available for deck or machinery duties. . . . The navy could not fail to gain enormously by the greater engineering knowledge of the commanding officer and the increased interest of the chief engineer, in whose hands must be placed everything connected with machinery, whatever its nature, on board a ship." In regard to the last sentence, it will be gathered that the functions of the American line officer are already more of an engineering nature than is the case with the executive officer of the British Navy. In our service the engineering branch is responsible (it is true, to the executive) for all the mechanical and constructional parts of the vessel, including watertight doors and double bottoms. Later on, Mr. Hollis says: "Let the commanding officers become engineers, and let engineers rule our ships; then all fears will be dispelled, and the navy will quickly become a unit;" the fears referred to being those attributed to the line officers that "the engineers wish to command the ships."

It would savor of impertinence on our part were we to attempt to decide what is and what is not desirable for the United States Navy, but we think that the most ardent advocate of "fusion" will agree with us when we say that the author of the article has proposed a very difficult and thorny programme. He has, however, the courage of his opinions, for at the end of the article he gives thirteen suggestions for carrying out the scheme he advocates. It will be fairer, perhaps, if we give these in full.

1. To make the course at the Naval Academy the same for all cadets, with a strong emphasis on engineering.

2. To give all graduates, except those entering the marine and construction corps, commissions as ensigns of the line.

3. To require all line officers to spend their first six years at sea, equally divided between responsible duties on deck and in the machinery department.

4. To permit any line officer to specialize in engineering during his second six years as a commissioned officer, and at the end of that time to transfer him to the engineer corps through examination in engineering.

5. To require at least one officer of the engineer corps on every ship, and to place under his charge all that pertains to machinery on board, including the men required for engineering matters.

6. To give all watch duties connected with repairing and driving machinery to line officers under the direction of the chief engineers.

7. To promote all officers of the line and engineer corps at the same rate and to the same ranks.

8. To make the total number of line officers and engineers together what it is now by law, with a minimum of about 100 officers in the engineer corps.

9. To regulate the flow of promotion by permitting a limited number of officers to retire after thirty years' service.

10. To provide a "reserve list" for officers who do not reach command rank young enough to be effective.

11. To promote all ensigns after three years' service in the grade.

12. To transfer to the line all officers of the present engineer corps who have held their commissions less than twelve years.

13. To establish a general staff in whose hands shall be placed all matters connected with the preparations of war.

It will be seen that Professor Hollis' proposals take a wide range, and it is questionable whether he has been wise in this respect, for he has given many opportunities for those opposed to him to attack on side issues. The main proposition, however, is clear enough; it may be summarized in the word "fusion." "Let the commanding officers become engineers, and let engineers rule our ships," he says elsewhere. Now, we have had proposals something on these lines in regard to our own navy, but they were not nearly so comprehensive as the scheme of Mr. Hollis, and they have borne no fruit; fortunately so, for it was suggested to give executive officers a superficial knowledge of engineering subjects, in order that they might have a greater semblance of authority in the engine room. Thus it will be seen that even the executive branch could not altogether blind itself to the absurdity of existing conditions; and no doubt executive officers felt that power and dignity would some day pass out of their hands into the hands of those having knowledge. The scheme they proposed was, however, so absurd and untenable that there never was a prospect of its being put into force. Mr. Hollis, it will be seen, would proceed on very different lines.

No reasonable person will deny that the officer in supreme command of a modern warship would be better equipped for his duties had he a knowledge of all parts of the vessel—including the propelling machinery—such as the captains of past eras had. The sole question that remains is, therefore, whether it is within the bounds of reasonable anticipation that such knowledge can be acquired without detriment to other qualities absolutely essential to taking a ship into action. Mr. Hollis appeals to "the teachings of history" in support of his contentions. He draws a most interesting parallel based upon what occurred in the English service 400 years ago. Before the sixteenth century the sailor occupied a somewhat similar place to that of our engineer, and the soldier took the place of our sailor. That was when seamanship, as we understood it, did not exist, and ships were little more than hulls, which were useful only for bringing soldiers to a hand-to-hand fight. The discovery of the art of sailing on a bowline, or beating to windward—which took place about the era of Sir Walter Raleigh—and the use of guns afloat altered all this, for seamanship thus became an art, by the exercise of which a military advantage could be gained. The man who could maneuver a ship thus held the key of the situation, and gradually, but not without a struggle, the sailor asserted his superiority afloat, for his knowledge of seamanship by no means detracted from his fighting qualities. The contest for supremacy was long and bitter, lasting, Mr. Hollis says, for over two centuries, but it gradually died away, being obliterated by a process of "fusion," such as is now recommended. "Some of the soldiers learned seamanship, some of the sailors learned the handling of guns, so that it was seamanship rather than the sailor that captured the command."

It was in virtue of this "fusion" that England gained the mastery of the sea, and to it Mr. Hollis very rightly attributes our victories in the Elizabethan era. Our fleet was intrusted to sailors—Drake, Hawkins and Frobisher—while the Spaniards clung to the ancient system of soldiers in command. "The poor equipment of the Spanish ships (of the Armada), and the ease with which they were rounded up, like a herd of cattle, forms one of the most melancholy pages of history," says Mr. Hollis. Englishmen naturally take rather a more cheerful view of the matter, but that does not affect the argument. Nothing, however, is easier than to misapply the teachings of history, and it by no means follows that because the navigating sailor and the fighting man of 300 years ago could be "fused," the captain and chief engineer of the present day can be welded together with equal success. The whole tendency of modern advancements ashore and afloat is toward specialization and division of labor. The problem of civilized existence is so complex, there are such vast stores of accumulated knowledge to be acquired, that life is not long enough to enable a man to become efficient in more than one branch. In the yard arm days there was one sort of gun, one sort of gunpowder, and but few sorts of shot. Small arms—smooth bore, pike and cutlass—were equally simple. Navigation was not more difficult to master—it was more uncertain in practice—than it is in the present day; but now we specialize into gunnery lieutenants, torpedo lieutenants, and navigating lieutenants, with whole systems of sciences to learn, and furthermore, a science of naval strategy and tactics such as the mast-and-sails commander never dreamed of. Even in the sailing days the maneuvering of the ships was left to the master, who remained as a relic of the old struggle between sailor and soldier, to which reference has been made.

So much may be said against the "fusion" scheme Mr. Hollis proposes, but the objections are by no means final. In support of his suggestions it may be said that, with the exception, perhaps, of strategy and tactics, the whole duties of the executive officers—gunnery or torpedo—are based on engineering science, all branches of which have a common foundation of elemental principles; and even strategy and tactics depend on the machinery department. Whether, therefore, the complete naval officer—at once steam engineer, gunnery expert, torpedoist and navigator—be possible is the question that has to be solved. It is no good for him to get a smattering of steam, just enough—as some now have—to make himself ridiculous. He must go honestly through the mill, and know his engines and boilers as he knows his guns and torpedoes, and that is a question of time. We cannot afford to have naval officers growing into old men before they have learned their business.

Whatever training the commander of a ship may go through, there is one thing certain, his place in time of battle cannot be in the engine room. Therefore, the captain of the ship can never be, at the same time, the chief engineer, whatever his previous training and his engineering accomplishments may be. If, however, the captain cannot be the engineer, the engineer can become a captain; and, indeed, the present regulations which put an engineer officer under the orders of a gunner or a boatswain, in absence of a commissioned executive officer, are an anomaly which should speedily disappear.

There is one other point to which we would make reference, although it is not dealt with in Prof. Hollis' contribution, before concluding this article. We refer to the question of titles as apart from rank. In our own navy all engineers, from the engineer in chief downward, have no title or designation in virtue of their office, standing on the same platform as ordinary civilians in this respect. In the United States it is somewhat different, as there naval engineers holding high office are allowed combatant titles; for instance, the chief engineer of the United States Navy is known as Commodore Melville. At first sight this seems a small matter, and for our own part we have always considered the profession of the engineer so honorable that it carried distinction sufficient in itself. In the navy, however, there is doubtless more to be said, especially in regard to vessels serving abroad. In foreign countries it is customary for naval and military officers to be addressed by the name of their rank; that is the distinguishing mark of "an officer and a gentleman." If, therefore, a naval lieutenant and a naval engineer are in foreign society, and the engineer is simply Mister Jones, while his brother officer is Lieutenant Smith, the former gets very small consideration, and no doubt people often wonder whether he has any right in the drawing room at all. This is annoying even to the most philosophically inclined engineer, and though those not subject to the same disadvantage affect to make light of these matters, we have noticed that captains, and even admirals, are not overpleased if their rank is forgotten. The fact is the great inducement to the majority who join the combatant services is not the prospect of high pay and material advantages, but the honorable distinction and social prestige attached to the holding of a commission, and of this the military prefix is the outward and visible sign. As there are gunnery lieutenants, torpedo lieutenants, and navigating lieutenants, why not engineer lieutenants? It is said the engineer is not a combatant; that is a fiction. The whole war ship is a weapon of offense, and in handling the engines the engineer performs an act of fighting below as much as the captain does when he works the telegraphs in his armored conning tower on deck—especially if ramming operations are in contemplation—or as the torpedo lieutenant does when he directs the operating of a submarine torpedo discharge, also below the water line. The engineer officer wears a sword and we should like to ask whether, in the case of his ship being boarded, he would be expected to tamely submit to his engines being interfered with by the enemy so long as the colors were at the mast.—London Engineering.

The largest locomotive in Europe, and probably in the world, has just been completed at Liége to the order of the Belgian government. It is built on the compound system, having four cylinders, two each of high and low pressure, with respective diameters of 32 in. and 20 in. The wheels, of which there are twelve, have a diameter of 52 in. The extreme length of the locomotive is 55 ft. 6 in. and its weight is over 200 tons.

THE MANUFACTURE OF BRIQUETTE FUEL.

DURING the last two years there has been an abnormal supply of small coal on the market, which has partly been absorbed in the manufacture of coke, partly used in ordinary industrial undertakings and partly resolved into the form of briquettes. Nevertheless, the supply has been so much in excess of demand that in many districts small coal has been sold at perhaps not more than half of the cost of production, assuming that cost to be—as it really is—the same for small as for large coal. Increasing attention is now being given to the use of such coal for the manufacture of briquettes, which have been found specially well adapted to locomotive and shipping purposes, and can be exported to greater advantage than almost any other form of fuel. Much, however, still remains to be done in this direction, and the moment, therefore, appears to be opportune for reviewing the development of briquette fuel and making suggestions affecting its manufacture and applications in the future.

Like many other inventions and applications, it is difficult to fix either the period or the place of the first practical employment of a moulding process for the manufacture of small coal into bricks with the admixture of coal tar or bituminous matter. The first name extensively connected with the subject in this country was that of Mr. Warlick, who applied the process in South Wales with considerable success. About 1853 Messrs. E. and B. Johnston, of Chester, were the makers of some sets of mixing and moulding machinery employed in the North Wales coalfields, but except in the principality, very small use was made of the system.

On the Continent more general use has been made of methods for the consolidation of coal slack. Extensive use was made of it as a locomotive fuel within a few years after the first lines were opened on the Continent, and its employment may be said to have been general before 1850. The machinery for mixing and moulding now most generally employed in France and Belgium is that suggested by M. Evrard, and extensively used in the St. Etienne coal district, models of which were shown at the first Paris exhibition. This system embodied a principle borrowed from an English patent of earlier date for the consolidation of peat or coal by pressing it through a cylindrical untapered tube, relying on the friction of the mass in passing through for the resistance necessary to give the required compression to the fuel. M. Evrard used a vertical shaft with a single eccentric or cam acting in succession on a number of horizontal rams ranged radially around it. As these rams reciprocated they allowed portions of the mixture of coal dust and tar (a mixture effected at a temperature of about 300°) to fall before them, which, on the forward stroke, they pressed through the tubes into which they worked and formed the briquettes.

Modifications of ordinary brick machinery having more or less power of giving compression have been extensively used both on the Continent and in Great Britain at different times. These blocks have largely been made of poor Belgian coal, the cementing substance being the pitch resulting from the distillation of coal tar. The materials having been ground very fine and especially well mixed and compressed, the blocks were coked in a muffle furnace for subsequent employment in metallurgical processes. The same plan has been employed extensively in Paris for the manufacture of the artificial charcoal called Charbon de Paris—a substitute for wood charcoal made from charcoal dust of peat and wood in about equal parts, associated with from 5 to 8 per cent. of pitch, which is, however, volatilized in coking, leaving a hard, dry charcoal block.

According to recent information,* the Blanzy Company was the first in France to make briquettes, their works commencing in 1845. The original plant consisted of hydraulic presses by which only one briquette was made at a time. Tar was used as the agglutinant, and the product had to be passed through drying stoves for the purpose of giving it consistency. New methods of mixing and increased facilities for large production rendered new machinery necessary.

The plant now employed consists of two factories, one having three Révollier presses and the other four Biétrix presses. With the Révollier presses the method of manufacture consists in taking the coal dust containing 14 to 15 per cent. of water from the draining tanks of the washing house and tipping it into a pit, from which it is raised by buckets to a hopper in the upper part of the works. From another pit dry pitch is raised in buckets to the same hopper. The buckets are so arranged as to deliver 9 per cent. of pitch to 91 per cent. of coal. After being mixed by passing through endless screws, the coal and pitch is "pugged" for eight or ten minutes in a pug mill. The mill is jacketed with superheated steam. The mixture then falls into the moulds, and is compressed by means of hydraulic rams, averaging from 142 to 156 lb. per square inch. This lasts about half a minute, and leaves only 4 per cent. of water in the briquette. After compression the patent fuel is left on a haulage chain for 40 minutes, when it is ready for loading. The three machines produce 240 tons daily.

With the Biétrix presses the coal, before being pressed, is dried to remove the large quantity of water which it contains. The coal and pitch are mixed in definite proportions, and carried by endless screws into a revolving reverberatory furnace. The mixture, after turning round from 8 to 16 seconds, is taken by an inclined creeper to the pug mill. It now contains from 6 to 8 per cent. of water, which is further reduced by the press, the pressure being 2,300 lb. per square inch. Each press makes 22 to 23 briquettes per minute, or an aggregate for the hour of 330 to 340 tons daily. An auxiliary press makes round or "cannon ball" briquettes.

The Biétrix presses only make one briquette at a time. The coal and ground pitch are raised by a Jacob's ladder to the upper floor of the factory, and each of them tipped into separate hoppers, two for the coal and one for the pitch. These hoppers deliver into rotary distributors, with recesses, moving at variable speed, and the proportion of pitch varying from 8·5 to 9 per cent. The distributers deliver on to a mixing screw, which in turn delivers on to the middle of a second endless screw, conducting the mixture into a reverberatory furnace with revolving sole, the two presses being fed by an arrangement of distributers, hoppers and endless screws. The mixture is delivered in the center of the furnace, where, owing to the rotation of the sole, it is seized by a mixing arrangement which stirs it while pushing it from the center toward the circumference. After remaining in the furnace from 8 to 10 seconds, the mixture both dried and heated falls into an inclined creeper, which raises it to the pug mill or mixing machine of the press, where it is subjected to a second stirring or pugging. The mixing machine delivers directly, by an adjustable outlet, on to the revolving table of the press, the recesses of which are filled as they travel underneath. After passing through the furnace, the mixture only contains from 6 to 8 per cent. of water instead of the 13 to 14 per cent. which it contained before. In order to regulate the pressure, the beam crosshead is articulated to a piston working in a hydraulic cylinder with valves. The press thus makes per minute from 22 to 23 briquettes, of a weight varying from 84 lb. to 87 lb., which are received on carriages and carried to the loading place. Rope haulage is often used to lead the briquettes directly to the shipping station.

There are numerous methods in use for the manufacture of briquettes, founded more or less on the description of presses employed. In France the principal types of press employed are those known as the Révollier, the Biétrix and the Zimmerman-Hanrez. As originally constructed, the Révollier presses made cylindrical briquettes; but, during the last few years, as much with the object of increasing the production as for giving the products a greater facility for stowage, the moulds have been modified so as to produce rectangular briquettes. The dusty slack, from 0 to 9 millimeters, brought from the draining tanks of the briquette washing floors in 20 cwt. wagons, is tipped into a pit and raised by a bucket chain to the upper floor of the works, these coals containing from 14 to 15 per cent. of water. A bucket chain placed opposite the former brings to the same hopper the pitch, broken by a Carr disintegrator. The dimensions of the buckets of the two chains, their number and their speed, are regulated so that the proportion of pitch shall be about 9 per cent. The mixture of coal and pitch passes from the hopper into an endless screw, which, after a preliminary mixing, distributes it to other endless screws, directly feeding the pug mills or mixing machines, which, about 8 ft. 6 in. high, with an internal diameter of 3 ft. 2 in., are steam jacketed and provided with an injection of superheated steam. After a mixing of from 8 to 10 minutes, the mixture falls through a movable door onto the mould that is being filled, where it is spread out and leveled with a shovel, the filled mould then passing on to be compressed. Large pumps are used to subject the water to a pressure often of 660 lb. to the square inch, and finished by that of small high pressure pumps, by which the water is subjected to a further pressure of 5,700 lb. per square inch, which, with a total effort of 540 tons on the hydraulic piston of 18 inches diameter, produces on the briquette a pressure of 142 lb. to 156 lb. per square inch. One of these presses can make from 8 to 10 tons per hour.

The formation of fuel blocks by the admixture of tar with small coal has the drawback of increasing the amount of smoke developed, as well as the disadvantage of a certain amount of disintegration which takes place in the furnace as the binding substance melts. It has, therefore, been from time to time proposed to substitute for bituminous matter glutinous, farinaceous, or starchy materials, and several patents have been taken out with this view. The first practical application of the plan is said to have been made under Barker's patent by the London Patent Coal Company, at Northfleet, and the system adopted was described by Mr. Bassett, C.E., about thirty years ago, before the South Wales Institute of Engineers. The small coal was tipped from the wagons into a chamber the bottom of which fell toward the center, whence it passed into a disintegrator and was reduced to one uniform size. It then entered a pug mill, into which was fed a continuous and regular supply of mucilage to be thoroughly mixed with the coal. This mucilage was composed of about 8 lb. of farina (potato starch) and 1 oz. of carbolic acid; the whole was mixed in about 25 gallons of boiling water, and resulted in a paste or liquid glue. The above quantities gave sufficient adhesive compound for the formation of a ton of artificial fuel, at a cost of about 1s. 2d. for the ingredient. After mixing, the blocks were formed in a brick or other moulding machine, and required from 9 to 12 hours to dry in a chamber heated uniformly to 300°. The advantages claimed for this fuel over that manufactured with pitch were that it gave considerably less smoke, and that there was no loss of efficiency in the furnace due to disintegration, as the action of heat tends to harden, instead of to soften, the farinaceous cement. On the other hand, the process was more costly than the ordinary one, in consequence of the cost of the mucilage and of the drying operation. When it becomes necessary to carry with more or less care and to pile in some order so low-priced an article as common fuel, the expense of such operations tells heavily upon profits, and the construction of chambers large enough to hold 50 or 60 tons of fuel spread out for drying is no inconsiderable item, to say nothing of the cost of maintaining them continually at a temperature of 300°.

At a briquette factory recently built in connection with the Fröhliche Morgensonne Colliery, near Wattenscheid, Westphalia, the slack is tipped into a storing tower, from which it is led to the point where its mixture with ground pitch is effected. The mixture is then led to a distributing hopper, and thence into two directly fired heating ovens. After the mixture has been thoroughly warmed, it is led to the Couffinhall presses, which produce briquettes weighing 6½ lb. to 11 lb., three presses turning out 175 tons of briquettes in a day of 10 hours. The larger briquettes are chiefly used for firing marine boilers and the smaller for those of locomotives. There are four steam engines employed, one for the dry separation, one for the washing, one for the briquette factory and the fourth for leading away the coal from the drying receptacles to the briquette works. This arrangement allows of work being carried on independently in each department.

A recent writer points out that almost any resinous or tarry matter may be used in the manufacture of briquettes. Seaweed boiled down in water may be very advantageously used by colliery owners whose works are situated near the coast. The weed on being boiled for some hours produces a glutinous mass, and acts as a good binding material; it should be mixed with the coal dust in the pan. Pine sawdust, 7½ per cent., mixed with the coal dust before going into the pan, improves the quality of the briquettes. Any kind of sawdust may be used, but pine is the best. The quantity of each binding material necessary can be best ascertained by experiment, and presents no difficulty.

* Paper on the briquette factories at the Blanzy Collieries, presented at the Chalon-sur Saône meeting of the Société de l'Industrie Minerale, by M. Dupont de Dinechin.—From the Iron and Coal Trades Review.

REVIEW OF THE PROGRESS OF THE HALF-TONE PROCESS IN THE YEAR 1896.*

By Count VITTORIO TURATI, Milan.

THE last year has enormously contributed to the extraordinary progress of half-tone processes in recent years, though the end of it shows an undoubted standstill in research and advance toward perfection.

Apart from the numerous very immaterial experiences published, we need only consider here those results of general interest.

SCREEN WORK.

Commencing with screen photography, we must state now, as before, that among the many screen systems prepared and tried, the cross line screen—with equal thickness of line and spacing—maintains its high place always with advantage, and enables the best and surest results to be attained.

A multangular screen which has been suggested, consisting of two line systems, moving one on the other, has offered no special advantage in practical work. On the contrary, it makes the work more difficult for the operator by the detailed manipulation requisite.

The many proposed grain screens, also, do not fulfill the promises which we long anticipated of them. They give always coarse prints with raggedness in the fine details, and the numerous attempts to substitute the screen by direct transfer from a coarse grained collotype plate has likewise, from easily conceivable causes, not led to any practical results. On this subject we can best acquaint ourselves by reference to an article published not long ago by A. Albert.†

The new four line screen of Levy gives—as shown by samples kindly sent to the author by Mr. Levy himself—very excellent results. By reason of two of the lines of the screen system being much finer than the other two, we obtain (with correct exposure and treatment) only one dot in the high lights, whereas in the shadows two dots appear in the same area. This solves a problem on which many investigators have worked for several years, a solution built up on the fundamental principle of the chemical correction.

This interesting four line screen is, however, very difficult to produce in large sizes, the cause of which is, as can be readily conceived, that the four line system has to be brought to an exact mathematical correspondence, which imposes a truly enormous task on the excellence of the machines used and the skillfulness of the manufacturer. It is nevertheless to be hoped that the well proved genius of Mr. Levy will overcome the above named difficulties.

On the principles of using the screen and stops, much has been written this year, but all these articles have advanced nothing on the fundamental work of the previous year, 1895, or at any rate very little that is new. The method of focusing for the screen distance, first proposed by the author, has proved in practice exceptionally successful.

The treatment of the collodion negative should be, as far as possible, conservative; the chemical correction is, however, a safe and sure auxiliary means of making faultily exposed or developed negatives useful.

To correctly work after Eder's rules, which are built rather upon a theoretical foundation, presents too many difficulties to the practical operator. Unfortunately this holds good up to the present day, but the time may not be far distant when better craftsmen will make themselves so acquainted with the principles of optical focus that it will be absolutely without difficulties to them. The above mentioned articles are recommended for study, especially the treatise on screen distances (Atelier des Photographen, 1896, page 191). The author has brought his own photographers to this standpoint already.

PROCESS PLATES.

Dry plates on the market for screen work include several makes which are useful, but have not, owing to various disadvantages, popularized themselves generally in practical work; therefore, a really good plate would be acceptable to the professional worker.

Such a plate should show at least all the qualities of a wet collodion plate, and this has been attained already by the author, by a particular method. Professionals like Collardon, Aarland, Perutz, Hemsath, etc., have spoken in the highest praise of the quality and power of this new plate. Active preparations for its manufacture on a large scale, which presents no slight difficulties, are being made.

Relative to the preliminary experiments it may be stated that a large and peculiarly constructed machine has been built, which is already giving very good results. It is anticipated that next year—as building must be done—the production of these plates on a large scale will be carried out.

The Turati plate is a stripping plate, the stripping being done directly after flowing on a leather collodion.

A NEW PRINTING PROCESS.

The following is a printing process which permits of ordinary transfer, not reversed or stripped negatives (being thus especially suitable for half-tone dry plates):

We copy on a bichromated gelatine paper, which is developed in the ordinary way in warm water, and transferred to the polished metal plates. By burning in, the picture is hardened into an enamel, the paper carbonizes and the etching can be performed in the usual way.

The author has published an article on the chrome salt printing processes, in which a good deal is said on the theory of the colloids; among other things, that

* The Process Year Book.

† "Suddeutsche Photographen Zeitung," 1897, page 249.

gelatine putrified, respectively by means of acids or alkalies, and thus rendered soluble in cold water (metagelatine), is qualified in a high degree as a substitute for the inconstant fish glue.

ETCHING PROCESSES.

As regards the etching processes, the enamel process still maintains the foremost place. No other process, as regards beauty, freshness and brilliancy, surpasses the enamel etching. The quality of the results is not only due (as is generally believed) to the solidity of the enamel on the copper, but to the gradual penetration of the etching through the enamel film. This is for the most part the cause of the wonderful softness of the results obtained with it. The author first directed attention to this in an article on "Through Etching by the Enamel Process," describing a matter which had not been noticed before.

The author has also found that zinc which is crystallized and structurally changed by heating can be etched very well in specially prepared etching baths. Until now, the burning-in process has been regarded as impossible with zinc, because the ordinary etching baths have an insufficient and extremely irregular action on the modified zinc, and give therefore only rotten and coarse results. But we can, by using a mucilaginous preparation while etching with sedimenting acid solutions, etch even the most crystalline zinc deeply and smoothly. The acid proportion may be thereby very much higher, enabling us to execute a half-tone etching by this new method to the greatest perfection in two to three minutes. This new method offers besides the utmost safety and facility for the etcher.

The so called "cold enamel" processes, founded mostly on the employment of formalin and other mediums, before and after, have not proved satisfactory in practice, as might have been foretold.

RETOUCHING HALF-TONES.

Before closing, a few notes on retouching will not be out of place.

The negative retouching is as good as entirely suppressed. The main point is to secure properly prepared originals. For vignetting, clever operators use optical tricks only. They close the highest lights simply by using a suitably large stop, thus saving the retoucher the troublesome and time wasting stopping-out. If we are not well acquainted with this method, we can also do it by a short after exposure on the original without the screen interposed.

As to the retouching of the plates, we may mention only the interesting discussion developed at the commencement of this year, on the merits of pure half-tone and retouching in the woodcut manner. Without saying more, it is clear that with both methods, in the hands of clever people, excellent work can be produced, while on the other hand, botchers will produce in either case only bad and insignificant work. At all events, the pure half-tone process has arrived to-day at such a high state of perfection that such hand work, besides rendering an increase in price necessary (and there can only be found an excuse for it in certain subjects), is not now required. To-day, when on every hand—even in Japan—excellent work in half-tone photography is accomplished, it is a matter of surprise that it should be thought necessary to resort to such meretricious aids for producing satisfactory work. It is now, moreover, quite clear that this has been only an attempt to put out a lifeboat to save the mediocre wood cut from disappearance altogether. The time which has elapsed, although short, has already shown that this attempt has been futile.

MOUNTING AND FINISHING.

The router and modern machinery for mounting blocks have proved successful and readily find the widest utilization. Of course, such machines can only be employed in large, well founded establishments, being mostly imported from America and very expensive.

For large editions it is always best to face the blocks with copper or respectively with nickel. This is not difficult by galvanic means. Recipes for coppering the blocks with a simple solution are old and consist of an ammoniacal cyanide solution of copper. Nickel recipes of a similar nature also exist, but have been kept secret until now. The use of cyanide has its great inconveniences, however, and the author has studied methods of avoiding it entirely; in his atelier zinc blocks are now copper and nickel faced by means of quick acting, inexpensive and not dangerous baths.

PRINTING HALF-TONES.

So much on the production of half-tone blocks. As to the printing of the same, very little new is to be said. A good overlay, or better still, a well executed photo-mechanical relief overlay, is always necessary.

Very beautiful effects can be produced with tint printing. This tint can simply be smooth, or preferably from a prepared plate, under-printed in the shadows. The "photo-chemigraph" seems to be founded on a similar principle—a process which gives very beautiful results.

Experiments done by the author by over-printing single but opposite lined half-tone blocks have rewarded him with very excellent results. One block is first printed in a pale tint, and then the other in a soft intense illustration color. The blocks should be produced by the Isotypie process, and be of exactly the same size; the dotting must be very exact to avoid disturbing patterns.

A COMPARISON IN THE METHODS OF WORKING BRASS AND ALUMINUM.

ACCORDING to the new price list of the Pittsburg Reduction Company, which went into effect on October 15, it will be seen that aluminum sheet, even in small quantities, is cheaper than brass if the fact of the difference in specific gravity is taken into consideration. This great reduction in the price of aluminum sheet will undoubtedly cause a very material increase in the demand for aluminum to replace brass, and a few suggestions regarding the relative methods of working brass and aluminum may prove of interest.

To commence our comparison, let us take up the question of what changes the manufacturer would have to make, who is now spinning articles of brass, in order that he could substitute aluminum in these same articles. The only real change that is necessary is a change in the lubricant used, as the lathe speed is practically the same as well as the tools; only a lubricant of vaseline should be used on aluminum instead of the ordinary lubricant which is used in spinning brass.

After a little spinning has been done, and the spinner has been able to determine the rapidity of "flow" of the metal, he will be able to handle it more quickly and easily than brass, for the reason that, with but few exceptions, aluminum sheet can be furnished of the proper temper to start with, so that when the article is finished it will be as stiff as it is possible to handle it. Whereas, in brass, if very much work is to be done on the metal, it is generally found necessary to anneal the brass between the successive operations of spinning in passing from one chuck to another. Thus time and labor are both saved in the spinning of aluminum goods.

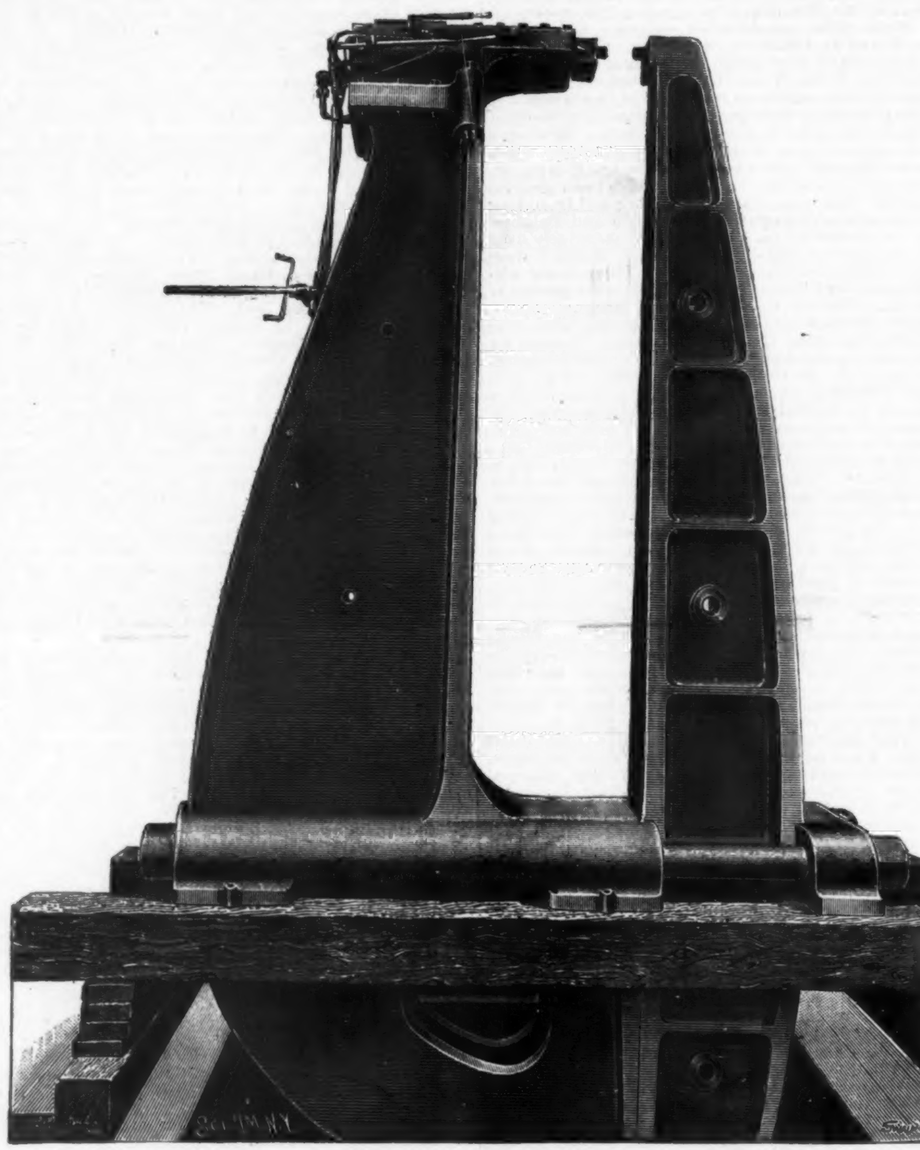
The same holds true in a comparison of spinning copper and aluminum, so that it can positively be stated that people having factories and machinery, and who are now manufacturing brass goods, can change the output of their plant to aluminum with practically no change in the machinery, and can make the articles they are now making out of brass out of aluminum in the future at a less cost, to say nothing of the money which would be saved by nickel plating where it is necessary.

In regard to a comparison of the stamping of copper and brass goods with aluminum, very little difference exists in the way of working these three metals. It would be well to note, however, that where one is using very thin aluminum sheet in the drawing press, the bottom of the male die should be so rounded that it will not cut or tear the sheet, which change can easily be made in any die at little or no expense. The lubricant in this case should also be vaseline, and not the oils or soap and water used on brass and copper.

Some factories to-day, that are both spinning and stamping aluminum goods, make the statement that they pay their men by the piece, and that they make more money and would rather handle and manufacture articles of aluminum at the same rate per piece than they would of any other metal. In regard to the drawing of very heavy sheet in presses, where it is only drawn in one direction, better results will be got by drawing the metal across the grain and not parallel to it. Aluminum, while of a short fiber, has a distinct one, similar to steel, running the length of the sheet.

A comparison of working brass or copper and aluminum on the lathe is also partically identical with all three metals. The greatest change here that has to be made is in the lubricant. For lathe work, or where any drilling or cutting is necessary, the best lubricant to use is coal oil or water. Coal oil gives the best results. Quite a large class of work, however, is performed dry, with excellent results. In some lathe work, such as the cutting of fine screws, etc., it may be found advisable to decrease the speed of the machine from the speed which would be used in turning brass, until the working of the metal is entirely familiar to the person handling it. After the particular peculiarities are established, which all metals possess to a greater or less extent, it will be found that aluminum can be worked in all cases more efficiently and rapidly than brass.

In starting a line of experiments with aluminum, however, it would be advisable to inquire particularly as to the relative merits of the alloyed sheets of aluminum and pure metal. In the majority of cases where aluminum fails to answer satisfactorily the purpose for which it is endeavored to be used, it is because the experiments have been conducted with the pure metal, whereas alloyed sheet should have been used. Pure aluminum compares with the alloys of aluminum exactly in the same way as pure copper compares with brass, and with but few exceptions, such as where electrical conductivity comes into the question or the effect of acid on the metal, is copper ever used; brass being considered the more desirable on account of its cheapness, as well as its greater strength and its general advantages. While the price of pure aluminum and the alloyed sheets of aluminum is the same in the majority of cases, it is found more advisable to use the alloyed sheet.—Aluminum World.



HYDRAULIC RIVETER.

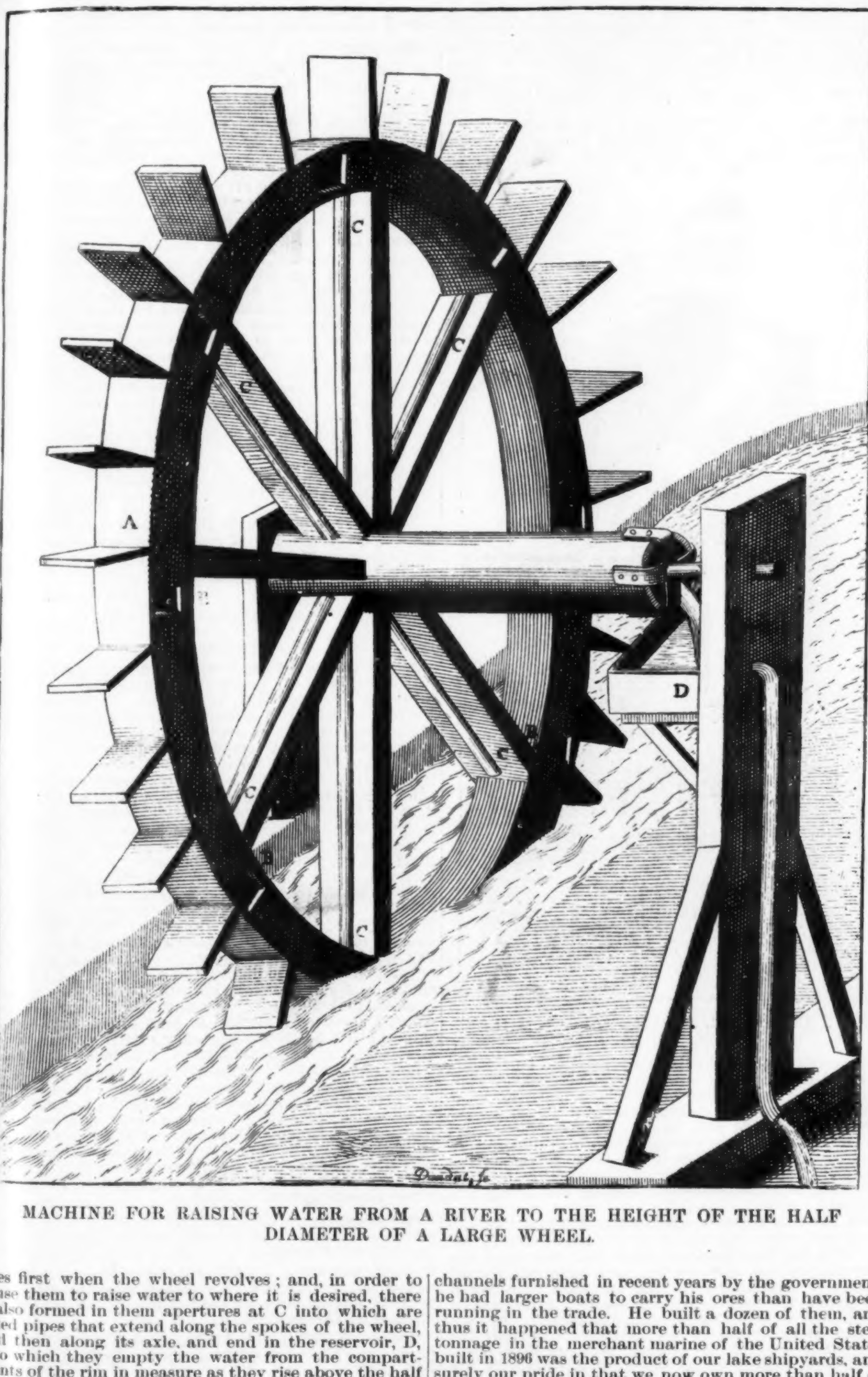
LARGE HYDRAULIC RIVETER FOR LOCOMOTIVE BOILERS.

THE illustration above shows a long gap stationary riveter, specially designed for riveting a complete boiler shell at one plating. It has a gap of 16 ft. 6 in., and exerts a pressure of 50 tons upon the rivet. The main body is of cast iron of heavy box section, while the hob is of open section mild cast steel. The two are held together by a pair of very strong through bolts, having a large margin of strength to prevent any yielding under the pressure of the ram, so holding the hob very rigidly up to its work. The riveting head is bolted loose upon the main standard, and has a long projecting beak which permits of a steam dome being riveted to the boiler barrel by the machine. To enable the rivet snaps to get more closely into all corners, the cylinder slide and the top of hob are fitted with snap holders having six sockets—two right, two left hand, and two central, in two rows, one above and one below. By this means the machine is enabled to get at every rivet in a locomotive boiler or firebox, with the exception of one row in the top of the latter,

which, however, can be riveted by a special appliance if desired. The cylinder and slide are in one mild steel casting, bushed with gun metal and provided with large planed guide surfaces. The slide is held down in its guides by a pair of planed steel bars secured by set bolts. Great economy of water is secured by a special arrangement of water-saving gear, which causes the slide to be run out until the snap touches the rivet, the cylinder meanwhile being filled from an overhead tank. As soon as the snap touches the rivet, pressure is admitted to the cylinder to complete the operation. We are indebted to the London Engineer for the cut and copy.

MACHINE FOR RAISING WATER FROM A RIVER TO THE HEIGHT OF THE HALF DIAMETER OF A LARGE WHEEL.

THE fellies of the large wheel, A, must be so constructed that they shall be hollow within, and that, being separated from each other, they shall form so many boxes capable of filling with water in passing into the river. To this effect, an aperture is made in them at B, that is to say, at that part of each felly that



MACHINE FOR RAISING WATER FROM A RIVER TO THE HEIGHT OF THE HALF DIAMETER OF A LARGE WHEEL.

rises first when the wheel revolves; and, in order to cause them to raise water to where it is desired, there is also formed in them apertures at C into which are fitted pipes that extend along the spokes of the wheel, and then along its axle, and end in the reservoir, D, into which they empty the water from the compartments of the rim in measure as they rise above the half diameter of the wheel.

As the current of the river causes the wheel to revolve through the paddles with which its rim is provided, the fellies of the latter succeed each other continuously, take up water from the river and carry it in abundance to the height that has been proposed, that is to say, to the reservoir, D, which is at the level of the half diameter of the large wheel, A.—From Recueil d'Ouvrages Curieux de Mathematique et de Mécanique.

Owing to the death of William L. Winans, the American millionaire, who died on June 25, his two "cigar" yachts, which have been moored in Southampton Water for twenty-five years, will be sold. Enormous sums of money have been spent in experiments upon them, but few people have seen them under way.

THE COMMERCE OF THE GREAT LAKES.*

By CHARLES E. WHEELER.

THE disastrous panic of 1893 was not without its benefits. It not only revealed the necessity of a reform in our monetary system, a lesson as yet blindly unheeded by the nation, but taught as well the need of industrial economies, and along this line most commendable progress has been made. During the past three years every manufacturer's office has been a school room, whose instructor has been Necessity, and the lesson that of applied economics and cheaper production. Mr. Carnegie, for instance, was an apt student and learned the lesson quickly. He built a railroad from the south shore of Lake Erie to his furnaces on the Monongahela and cut the rail carrying charge in two. He went beyond that. Availing himself of the dilemma of Mr. Rockefeller, possessed accidentally of several large deposits of ore on the south shore of Lake Superior, he was able to place himself in a position as regards ore supply to compete with the world, at the same time lowering the transit cost of the ore from the mine to his railroad. Mr. Rockefeller in turn saw meager profits, unless, availing himself of the deeper channels furnished in recent years by the government, he had larger boats to carry his ores than have been running in the trade. He built a dozen of them, and thus it happened that more than half of all the steel tonnage in the merchant marine of the United States built in 1896 was the product of our lake shipyards, and surely our pride in that we now own more than half of the merchant marine of the United States, as regards boats of 1,000 tons burden and over, is quite pardonable.

Everywhere, less noticeable because on a lesser scale, the same trend toward the same end is to be found. It has not received the attention it deserves—the constant, determined, intelligent effort of the American manufacturer, during the years of financial trial, to open new markets, stop wasteful expenditures, cheapen production. With returning prosperity he is rash who will set limitations on American trade abroad or at home—a result of the discipline of 1893-94-95. The growth of our export trade in the iron list is unmistakably genuine, recognized and frankly acknowledged by English competitors. The Duke of Devonshire, at the meeting of the Barrow Company directors, spoke of it as "alarming." The London Times, commenting on his declaration, marvels at the magnificent scale of operations at Homestead, where it finds furnaces each producing 200,000 tons of pig iron per annum, the average capacity of the English furnaces being less than 24,000 tons per annum. During the last month or two rails for Liverpool have been coming to tide water all rail from the Cleveland district. Nails and wire rods have been going abroad in generous quantities. The future is full of hope, if unwise legislation does not create more artificial barriers than the ingenuity of the American manufacturer can overcome.

Contributing to this happy condition of affairs, the cheap transportation on the lakes has been a factor of prime importance. The transporting interests on the inland waters have not failed to meet the new situation with intelligent effort and splendid courage. It was inevitable that cheaper transportation should come. The 20 foot channel from Duluth to Buffalo is practically completed, and the invitation to larger boats and cheaper rates could not be denied. Besides, the traffic itself is of such magnitude as to compel a minimum rate. Over that course of commerce must come the nation's breadstuffs, its lumber, its iron ores and copper in quantities that pass comprehension. The figures for 1897 are, of course, not yet complete, but there is little doubt, if any, that the most prosperous year will be equaled, even surpassed. If this proves true, over 38,000,000 tons of freight will have passed through the Detroit River in 1897. Load that freight in cars, 20 tons to the car, place the locomotive at New York, and the caboose will be in New York as well, but between the two nearly 2,000,000 cars will be found, extending across the continent to San Francisco, back again to New York, again across the continent, again back to New York. It is a greater commerce than that of Liverpool or London, foreign and coastwise, greater than both combined. It exceeds the total entries and clearances in the foreign trade at New York, exceeds the total of like entries and clearances at all the seaports of the United States. I am speaking of quantities, of course, not values.

Imagine, if you can, the uses to which the freight is put, the industries it nourishes. Sixty-six per cent. of all the ores used in the United States comes through the Sault, and, notwithstanding the bright outlook and flattering showing made by the Alabama and Tennessee district, the percentage of the total amount of ores used is not only markedly in favor of the Superior ores, but the percentage increases year by year.

Two-thirds, then, of all the ores used in this country come from the south shore of Lake Superior, and are the sole source of supply of such mills as those of the Carnegie Company, the Illinois Steel Company, the Johnson Company, the Cleveland Rolling Mill Company and others that are now confessedly equipped to compete for foreign trade. If our hope in the future supremacy of the American iron and steel maker is well grounded, surely we may look for its justification in the furnaces between Cleveland and Pittsburg. There, if anywhere, must be found the means by which in an iron age this country may assume a commanding position in the iron markets of the world.

And the whole matter depends on cheap transportation. Remove the chain of lakes, and no railroad or system of railroads could hope for a moment to place the 140 different iron and steel manufacturers in the Central States district in a position to compete with foreign mills, and in the catastrophe thousands of allied industries must inevitably be abandoned. For the coal for the coke is in western Pennsylvania and the ores over 900 miles away. No railroad in America is better equipped to transport freight cheaply than the Lake Shore and Michigan Southern. Its grades are light, its tracks and roadbed unsurpassed. The cost per ton mile in 1896 on that railroad was 3·81 mills; the cost on the lakes 0·99 mill. We have this year reduced the latter figure fully one-third in the operation of the larger boats. We have been bringing ore from the south shore of Lake Superior to Cleveland at a rate of but 15 cents per ton over the ordinary railroad switching charge in any of our large cities. We have been taking coal back at one-third the New York lighterage rate.

To reach such results has demanded the most rigid regard for economies in every direction. It has worked a revolution in loading and unloading cargoes. It became necessary that appliances should be such that 6,000 tons of ore could be loaded into a boat, the boat trimmed and ready to depart for her eastern terminus within four hours after tying up to the dock. It became necessary that at this end of the line those 6,000 tons should be unloaded in ten hours. It became necessary that 40 cars an hour, each car containing 25 tons of coal, should be lifted up bodily one at a time, and the contents discharged into the boat as easily as a laborer flips his shovel.

When Mr. Carnegie amazed the world last spring with his low quotations and other mills followed, let it not be forgotten that it had been impossible but for our shipyards, the genius of the mechanical engineer, and our steamship organizations, which have availed themselves of every known appliance for the economical conduct of their business. Had it not been for them and the lakes, Mr. Carnegie had sought in vain for his foreign market, Mr. Moxham had returned from Liverpool empty handed, and the Cleveland rod and nail mills had never dreamed of Japan and England for profitable sales. The commercial supremacy of America in iron and steel manufacture is impossible but for the great lakes.

And now let it not be thought that the greater part of that traffic is the carrying of iron ores. It is nearly a half of the tonnage, it is true, but in value occupies but fourth position. The total value of freight passing through St. Mary's Falls canals in 1896 was over $195,000,000. Of this amount wheat must be credited over $47,000,000; flour, $34,000,000; unclassified freight, $31,000,000. Iron ore with $25,000,000 comes next, closely pushed by copper with $23,000,000 to its credit. If the grain shipments out of Chicago and the lumber shipments from Lake Huron be added, and again there be added the value of the coal and merchandise shipments from Lake Erie to Detroit and Lake Michigan ports, the importance of iron ore in the list is not so readily recognized, and it will be seen that what I have said of the lakes and their relation to the iron industry ap-

* Read at the New York meeting of the Society of Naval Architects and Marine Engineers.

plies quite as well to wheat, corn, oats, flour and possibly copper.

It is almost certain that the indirect effects of lake transportation are of greater importance than the direct. Mr. Blanchard, in his argument of March, 1894, before the Committee of the United States Senate on Interstate Commerce, made a significant and, as I believe, absolutely truthful statement in these words: "I contend," he said, "that after rivers, lakes, oceans and economic forces have spent their combined natural and national powers in determining rates which are reasonable, such rates cannot be made excessive by combination." Mr. Blanchard was defending railroad pools, a question alive to-day and destined to command careful public consideration in the years to come. As a representative of the railroad interests his plea may be that of an advocate, yet the fact is he was entirely correct. No railroad or combination of railroads can dissociate itself from the traffic means we are considering. It is a controlling factor, and if Duluth can ship her flour from that port to Liverpool for 14½ cents per hundred—a privilege she enjoyed for a brief time the past summer—its effect is instant upon every railroad that has flour mills to protect or grain to haul to them. And then, too, it is not iron ore, flour and wheat that alone monopolize the low rate. The class freight annually carried over the lakes between the great commercial centers, Chicago, Milwaukee, Detroit, Toledo, Cleveland and Buffalo, and beyond in connection with the rail lines and the Erie Canal, is an item concerning which, unfortunately, no accurate data are at hand, thanks to a law which does not exact reports of any considerable statistical value; but the fact that all your trunk lines whose western terminus is Buffalo own and operate their own boats, and the fact before cited that the unclassified freight in the Lake Superior trade amounts in value to over $30,000,000 per year, hint at the enormous value of the total class business transacted in the lake trade. None of the trunk lines may ignore it and its influence is far felt. If it became a traffic necessity for the Lake Shore & Michigan Central and the New York Central & Hudson River Railroads to approximate the lake and rail or lake and canal rate on any commodity from Chicago to New York, be sure the other trunk lines will meet it, and give their tide water terminals the same rate, not omitting the differentials. As was the case this summer, even the north and south lines, such as the Illinois Central, must of necessity take a hand, protecting their Gulf termini against the competition thus forced on them. Now, while its effects are of little consequence, perhaps in regard to higher class freight, there can be no question but all the 6,000 railroad stations east of the Mississippi and north of the Ohio River reap a decided benefit in the carrying cost of the lower class freight and commodities; for when through rail rates are reduced between Chicago and New York for instance, because of lake competition, they are simultaneously reduced between intermediate points because of the long and short haul clause of the interstate commerce act. The effect is widespread, often disastrous to the carrier, but at least yields this comfort: That the present unmistakable tendency toward concentration of railroad interests or the enactment by Congress of a law permitting railroads to pool is a menace of academic rather than real interest. So long as our water highways are open, the railroads have a competition that cannot be overcome.

There is another reason why this competition is irresistible. In the building of boats and their machinery, the naval architect and marine engineer may hope reasonably to keep in advance of the maintenance of way engineer, the master car builder and the superintendent of motive power. Walking through the Globe shipyards one day with Mr. Parkhurst, he picked up a piece of coal the size of a walnut and remarked: "You would hardly think that little lump of coal will carry a ton of freight a mile, would you? and yet that is what it will do on our better class of boats." It is true—fifty-five hundredths of an ounce of coal per ton mile is the record.

Now, such results are not to be expected in the performance of a locomotive; at least they are not in sight. Such economies are associated with triple and quadruple expansion engines, and it is worthy of note that, for the first time in the history of shipbuilding in America, we on the lakes are now building our freighters with quadruple expansion engines. Then, too, our waterways are being deepened, our boats enlarged. Until last year they were less than 400 ft. long. We are now building them 475 and 500 ft. in length over all.

There is in a workshop at Cleveland an internal combustion engine, built for the company with which I am associated. It weighs about two tons, and is, if I mistake not, the first compound gas engine that successfully meets all requirements. Its cards show an indicated horse power of 114 and a thermal efficiency of 39·5. Making no claim whatever to a technical mechanical training, I am perhaps treading on dangerous ground, but this at least is known: That reduced to steel strains we have an engine of 92 horse power per ton, a record far surpassing that of the Turbinia, an engine that exhausts at atmosphere and that may be built to any power if some of your own brightest marine engineers are not in error. In any event, it is certain the principle of a compound gas or oil engine is now thoroughly understood, and whether the present device fulfills expectations or not, assuredly the time is not far distant when important results will come from the untiring efforts of mechanical engineers to transfer the source of power from the boiler to the cylinder. I mention it because indicative of a possible revolution in mechanics that will work economies in the engine room of a vessel impossible to the locomotive, and thus increase the already marked difference between the cost per ton mile by water and that by rail.

Clearly we have not yet sounded the possibilities of cheap transportation by water, and with their discovery one may be justified in believing that their application can nowhere be productive of more beneficent results to mankind than on those waters to which are annually consigned the products of the vast plains of the West, the nation's food and the supply of her workers in iron.

London has 196 inhabitants for each square kilometer, Paris 265, Rome 280, Turin 340, Naples 939, and in her Pendino quarter 1,254.

A GALLANT REGIMENT.

The storming of the heights of Chagru Kotal has been justly described as one of the most stirring feats of war in Indian army annals. The story of the fight reminds one of "The Drums of the Fore and Aft," for it was the Highlanders and the Gurkhas who saved the day. The Gurkhas, it will be remembered, led the attack, and succeeded in getting into shelter inside the line of fire of the tribesmen, who were strongly posted on the hills. Next came the Derbyshire and Dorsetshire regiments, but the hail of bullets made them fall back. Then Col. Mathias called on his Gordon Highlanders. "Men of the Gordon Highlanders," he said, "the general says that the position must be taken at all costs. The Gordon Highlanders will take it." With the bagpipes rousing echoes in the hills, the men leaped to the attack and carried the positions in superb style. During this splendid rush Lance Corporal Piper Patrick Milne was shot through both legs, and he was brought helpless and bleeding to the ground, exposed to the deadly fire of the enemy as he lay in the bullet-swept zone. Milne, if not quite the first to leap into the zone, was among the first party of Highlanders. As he ran, he piped lustily the "Cock of the North." When shot down he managed to get himself into a sitting position, and with gradually diminishing vigor continued to play. But he was only one of five Gordon pipers who won praise by their pluck at Chagru Kotal. The other four sturdily marched across the zone fire, piping all the way. Only one got across unhurt. Three of them were wounded, one of them severely. Lance Corporal Piper Patrick Milne is an Aberdeenshire man hailing from Insch, where his

LANCE CORPORAL PIPER PATRICK MILNE.

father was a farmer. At the age of nineteen he enlisted at Aberdeen Barracks, and sailed for India in 1893. When he had been two or three months in India, Milne received his first good conduct badge. While at Sabatha he joined the pipe band of the regiment. He was with the Gordons through the Chitral campaign, and had then a wonderful escape. While playing his pipes a bullet struck the pipe bag within an inch of his side, rendering the pipes useless, but doing him no injury.

The First Battalion of the Gordon Highlanders, the old Seventy-fifth, was raised in the Highlands in the year 1787, but the Highland dress and title were discontinued in 1809, as there were not more than about a hundred Highlanders in the regiment. In 1862 it was given the title of Stirlingshire. Afterward it was linked with the Thirty-ninth Regiment. In 1881, on the introduction of the territorial system, the regiment reverted to its original position as a Highland corps, and became the First Battalion of the Gordon Highlanders. The First Battalion of the Gordons as a new Highland regiment soon won the respect and admiration of the rest of the Highland Brigade. At Tel-el-Kebir the First Gordons did splendid service, and for their conduct at Teb and Tamai they were highly praised in Sir Gerald Graham's dispatches.

A detachment of the regiment fought at Abu Klea and Gubat. In 1885 the regiment was again on the Nile, but had all the unpleasant work of campaigning and none of the fighting. Last year it took part in the Chitral campaign, being present at the taking of the Malakand Pass. Thus, since 1882, the First Gordons has taken part in four campaigns, assisted in six pitched battles, and is now engaged in a fifth campaign. We are indebted for our cut and particulars to the London Graphic.

SELECTED FORMULÆ.

A peculiar fabric, which may find employment for many purposes, is made in Brussels. It is flexible, transparent and impervious to water. This textile material can be washed off with cold water, like a glass pane, by means of a sponge, and is mainly to be used for portières, window shades, umbrellas, etc. The patented process for the production of this tissue consists in filling up the meshes of a wide-meshed fabric, such as muslin, etc., with chrome gelatine or with a similar material, and then rendering the chrome gelatine insoluble by exposure to light. The fabric is then coated on both sides with boiled linseed oil or fat varnish. The treatment with chrome gelatine and linseed oil is repeated several times, and the fabric is ornamented by printing.

Spontaneous Combustion of Resinfied Minium.—According to Prakt. Maschin. Konstr., resinified minium is subject to spontaneous combustion, as was proved by a fire caused by minium at a factory the other day. The hardened contents of a barrel of minium was broken up for the purpose of regenerating, and covered with bags overnight. The action of the oxygen of the air upon the fresh fractures of the hardened minium caused a development of heat in the same, under reduction to lead and ignition of the admixed varnish resins. Only by the vigilance of the factory watchman, a large accident was narrowly averted.

Red Ink.—

(1)	Carmine, No. 40	30 grains.
	Ammonia water	1 drachm.
	Acacia	6 grains.
	Water, q. s. to	1 ounce.

Dissolve the carmine in the ammonia, and add the other ingredients. The depth of tint may be varied by the use of more or less water.

(2) Half a drachm of powdered drop lake and 18 grains powdered gum arabic, dissolved in 3 ounces ammonia water, makes one of the finest of carmine inks.

White Ink.—White ink is made by suspending some insoluble substance in a liquid and applying with a brush or pen. In this way zinc oxide (Chinese white) may be ground very fine on a slab with a little mucilage of tragacanth, then thinned to the required consistency to flow from a pen. The mixture requires shaking from time to time to keep the pigment from separating. The ink may be preserved by adding a little oil of cloves, carbolic acid, or other antiseptic to prevent decomposition. All so-called white inks for colored papers are made from acids or alkalies which will discharge the color. The following preparation is used for writing on slate colored, blue or red paper:

Slaked lime	4 drachms.
Tragacanth, in powder	16 grains.
Glycerine, a sufficiency.	
Distilled water	4 ounces.

The lime is rubbed with the tragacanth and enough glycerine to make a stiff paste; rub for about fifteen minutes, and then add the water, and bottle.

The following is an ink for a blue paper:

Hydrochloric acid	1 fluid drachm.
Mucilage	30 minims.
Water	7 fluid drachms.

—Pharmaceutical Era.

Liquid for Gold Paint.—Stir the fine metallic powder into copal varnish previously thinned down to the proper consistency with turpentine. (2) Brannt gives the following: Melt dammar with an alkaline carbonate and expose the melted, finely powdered mass for several months to a temperature of about 122 deg. F. The alkaline resin thus obtained is dissolved in a hydrocarbon below 302 deg. F. Any acid contained in the hydrocarbon is previously neutralized by the introduction of dry ammonia gas. The mixture of this lacquer with the bronze powder keeps for a long time. (3) Pour over 100 parts of dammar and a few pieces of glass in a bottle 900 parts of benzine. Pour off the solution from the fine sediment and glass, and suspend in it 300 to 400 parts of bronze powder. Fill in small bottles. A gold paint or varnish may be made as follows: (1) Digest shellac, 16 parts; gum sandarac, mastic, of each 3 parts; gum gamboge, 2 parts, all bruised, with alcohol, 144 parts. (2) Artificial alizarine or garancine is to be digested in a glass vessel in three times its weight of alcohol for twelve hours, and pressed and filtered. A solution of clear orange colored shellac in alcohol is next filtered and evaporated until it has the consistency of sirup. The latter is now covered with a layer of tincture of garancine, which permeates it. The slight brownish tinge of this varnish—a tinge absent from gold—may be corrected by a tincture of saffron. (3) Pulverize 1 drachm of saffron and ½ drachm of dragon's blood, and put them into 1 pint of 90 per cent. alcohol; add 2 ounces of gum shellac and 2 drachms of socotrine aloes, dissolve the whole by gentle heat. Yellow painted work varnished with this mixture will appear almost equal to gold.—Pharmaceutical Era.

Old Corks can be cleaned by washing with water containing 10 per cent. of hydrochloric acid, then immersing in a solution of sodium hyposulphite and hydrochloric acid. Finally the corks are washed with a solution of soda and pure water, says the Pharmaceutical Era. Corks containing oil or fat cannot be cleaned by this method.

Manure for Flowers.—For hastening the growth of flowers the following fertilizer is recommended. It consists of:

Potassium nitrate	30 parts.
Potassium phosphate	25 "
Ammonium sulphate	10 "
Ammonium nitrate	35 "

Remedy for Locusts.—We give from Revue Scientifique a remedy against locusts, which has proved efficient in Natal: Dissolve equal parts of caustic soda and arsenic in thirty-two times their combined bulk of boiling water. Of this stock solution take one gallon, dilute it up to forty gallons, add ten pounds of brown sugar or sirup. In this solution soak straw or Indian corn stems, etc., and spread on the fields. The locusts, attracted by the sugar, eat the poisoned stems and die, others come and eat the dead locusts and are also killed.

ENGINEERING NOTES.

A diver in the Clyde recently worked for forty minutes at a depth of 186 feet, which is a record in Great Britain.

It is learned that the mammoth pontoon dock which is being built to Spain's order at Stephenson's yard on the Tyne is destined for the Philippine Islands, and not for Havana, as was at first reported. This dock is similar in size and construction to the one recently built and dispatched in tow for Havana.

A cable line has recently been completed connecting Puerto Cavello, Venezuela, with La Guayra, and thus with New York, by way of Curacao, Haiti, etc. A delay of many hours is avoided in the transmission of telegrams which formerly went over the national overland lines.

Consul Duester, at Crefeld, Germany, reports to the State Department a discovery made there which, it is said, will revolutionize the methods of illumination. It is an incandescent gas. A single jet of ordinary size can emit a light of much more than 1,000 candle power, and fine print can be read at a distance of 100 feet. The inventor says the cost for a light of 1,500 candle power is only 4½ cents per hour, while that for an ordinary electric light of 400 candle power is 14 cents per hour.

It is announced that the steamers of the Peninsular and Oriental Company will, after February 1, 1898, call at Marseilles instead of at Brindisi, owing to the niggardly policy of the authorities at the latter port in refusing to extend the local railroad half a mile to the quay for the accommodation of passengers and mails. This action upon the part of the officials of Brindisi makes them responsible for the loss of business involved in the landing there of 110 large passenger ships yearly.

We are informed that, for safety's sake, the receivers of the Baltimore & Ohio Railway have placed out of service nearly all of the old iron hopper cars which have been used on the Baltimore & Ohio for a great number of years. These cars, it is stated, were very weakly constructed, and if put in a train between the heavy modern freight and coal cars of to-day, are very likely to be crushed in case of a sudden stop, or a too strong application of air brakes. Up to September 30, 1,500 of these hoppers had been retired and thrown on the scrap pile.

The use of aluminum bronze is increasing for purposes where a strong and dense metal is required, says The Aluminum World. The amount of aluminum in aluminum bronze varies from a few per cent. up to 10 or 11 per cent., depending on the purpose for which the metal is intended. The strongest mixture contains between 10 and 11 per cent. of aluminum. Beyond this point the bronze is hard to work and becomes brittle. Aluminum bronze can readily be soldered. In soldering this alloy no such difficulty is encountered as is found in soldering pure aluminum. The best method of soldering aluminum bronze is to use pure block tin with a flux made from zinc filings and muriatic acid. It is well to "tin" the two surfaces before putting them together.

According to an article on the "Comparative Fusibility of Foundry Metals," in The American Manufacturer, the economy and advantages to be obtained by using chilled pig metal in foundries and in Bessemer steel works are as follows: First, being a harder iron by reason of its chill, or having its carbon largely in the combined form, as well as having the pigs free of sand, less fuel will be needed to melt it, and it can be made to come down faster in the cupola, thus saving time in melting. Second, the pigs being sandless, there will be needed less fluxing and slagging of a cupola in large heats, and this will also give a cleaner iron out of small as well as large heats from the tap hole. Third, its being chilled will cause it to be broken more easily. Fourth, the general use of chilled cast pig metal would do more to compel the use of chemistry in founding, because those who still make mixtures of iron by judging grades by fracture would be forced to work by analysis, as chilling a pig would more than ever disguise its chemical composition.

The rapid extension of the iron industry in European Russia, through the establishment of the several large new iron and steel rolling mills already erected, or now in course of erection in the country, has called into existence a new branch of the iron business which hitherto depended chiefly on foreign supply, says The Engineer, the construction of plants for the manufacture of iron and steel. New works for this purpose have just been opened in Riga by a company forming a branch of a similar one in Dahlbruch, in Westphalia. The Riga company has secured a well situated piece of ground of 17½ acres, so as to be able to extend its works to fourfold their present dimensions. The buildings and machinery, including a 30 ton crane, are all of the most improved description, and are provided with electric transmission of power and electric lighting. The designs for the machinery to be constructed will be furnished by the parent establishment in Dahlbruch. Germans, Belgians and Frenchmen are taking a firm hold on the iron production business in Russia.

Since the institution of cotton mills at Shanghai, the wheelbarrow has been extensively used as a passenger vehicle, especially for carrying workwomen to and from the mills. One man can wheel six women for a distance of about three miles, morning and evening, the charge being 35 cents per month. The average earnings of a wheelbarrow man are about 8½d. per day. About 4,000 licenses are issued monthly to the same number of wheelbarrows plying for hire in the streets of the foreign settlements at Shanghai, where, being under the municipal regulations, they are perhaps the best in China. Sometimes as many as fifty barrows may be seen in the streets, traveling one behind the other, each carrying two barrels of English Portland cement and pushed by one man. Very frequently a load is carried on one side of the barrow only, and it is extraordinary to see a Chinaman skillfully balancing and propelling it. The upsets and accidents, too, according to Cassier's Magazine, are remarkably few, when it is considered that about 4,000 of these vehicles are in use in the streets, in addition to a large traffic of other kinds.

ELECTRICAL NOTES.

Letter stamping machines are being experimented with on the trolley postal cars in San Francisco, the machines being run by motors that take current from the trolley circuits.

The street car system of Munich is to be wholly converted into an electric line system within the coming two years. The plant is to be three times as powerful as the one at Berlin, and is to supply electricity for lighting purposes and to private individuals, besides running the cars. Expenses are estimated at two and three-fourths million dollars.—Uhland's Wochenschrift.

Cutting Up Trolley Wires.—Not a month passes, says the Street Railway Review, of Chicago, but we record the loss of trolley or feeder wire which has been stripped from the hangers and is usually found chopped up into short lengths of a foot or two, suitable for melting into pigs to prevent identification. Some months there are several such reports, the losses ranging all the way from a few dollars to several hundred; and occasionally the damage done causes an expense of one or two thousand. The nuisance is not confined to any State, but is "prevalent all over."

From experiments recently made on specimens of iron of different lengths, Mr. Henry Wilde, F.R.S., has found the magnetization limit to be 422 lb. per square inch, or 29·67 kilos. per square centimeter. In his communication to the Royal Society, Mr. Wilde describes an experiment showing that the single pole method of determining the magnetization limit of magnetic substances compares favorably with the double pole method, and that no higher degree of tractive force is to be expected from the latter than has been obtained from the former method.

Under date of August 30, 1897, Consul Germain writes from Zurich: The total length of the world's telegraph system has now reached 7,900,000 kilometers (4,908,823 miles), exclusive of 292,000 kilometers (181,440 miles) of submarine cables. This mileage is apportioned as follows: Europe, 2,840,000 kilometers (1,764,790 miles); Asia, 500,000 kilometers (310,685 miles); Africa, 160,000 kilometers (99,419 miles); Australia, 350,000 kilometers (217,479 miles); America, 4,050,000 kilometers (2,516,548 miles). It will, therefore, be seen from the above that, notwithstanding the steady increase in the building of telegraph lines all over Europe, America leads and has almost double the mileage of Europe.

A novel method of illuminating the new Low library at Columbia University is being tried experimentally, says Electricity. The idea is to gain the advantage of diffusion from a large surface centrally located, and at the same time to be realistic. The plan being tried is as follows: Suspended in the center of the great hall is a large hollow globe seven feet in diameter and painted a dull white. This is not a receptacle of the light intended to diffuse the rays by transmission, but is opaque and intended to diffuse the rays by reflection. Upon this sphere are directed the concentrated beams of light from eight hidden arc lamps located at intervals along the gallery pilasters. The moonlight effect is heightened by the background of blue which constitutes the ceiling, and the effect is described as fine in the extreme.

Some rapid electric railway construction was recently accomplished near Bound Brook, N. J., where 2½ miles of road was constructed in 22 hours, including all grading and overhead line construction, by the New York & Philadelphia Traction Company in an effort to outwit a rival company and prevent the stopping of work by an injunction. The right of way between Bound Brook and Somerville was being disputed by the New York & Philadelphia Company and the New Brunswick Traction Company. The former quietly arranged with J. G. White & Company, of New York, to build the section during the 24 hours between 12 o'clock Saturday and 12 o'clock Sunday nights, says Engineering News. The work required the transportation of 600 men, four cars of tools and provisions, large quantities of poles and ties, lighting apparatus, tents, etc. The work was accomplished, current turned on from a temporary power station built on the property of an interested party, and a car run over the line within the allotted time, notwithstanding the opposition of the local authorities, who were obliged to succumb to the superior numbers of their opponents.

An electrical transmission plant has recently been completed by the Blue Lake Water Company in Alpine and Amador Counties, California, says Engineering News. Ten small lakes between 4,000 and 8,000 ft. above the power station, with a catchment area of about 67 square miles, form the source of water supply. By damming their outlets, a total storage capacity of 20,942,000,000 gallons was secured. These lakes discharge into the Mokelumne River, and at a point about 45 miles from the lakes the water of this stream is diverted into the Amador Canal. This is an artificial channel 42½ miles in length made through very rugged country. There is one tunnel and 82 flumes, aggregating 3·7 miles in length. The canal has a grade of about 8 ft. per mile, which gives a velocity of 300 ft. per minute and a capacity of 3,000 miner's inches. The ditch ends in a concrete forebay and settling basin, which also forms the upper end of the pipe line. This conveys the water a distance of 3,240 ft. to the turbines, with a drop to the point of delivery of 1,242 ft. The pipe is in five sections, which vary in diameter from 48 in. at the upper end to 15 in. at the turbines. Where flange joints were made, ⅛ in. sheet lead gaskets were used as packing, and these were compressed by drawing up the flange bolts until only ⅛ in. thick. In a test of sections of 15 in. pipe joined in this way, a pressure of 1,200 pounds per square inch was withstood. To anchor the pipe and prevent mechanical injury, the entire length was sunk to the surface of bed rock, and the last 400 ft. was embedded in concrete in a trench blasted out of the solid rock. Three 700 horse power Doble waterwheels 4 ft. in diameter, with a working speed of 600 revolutions per minute, are directly connected to three Stanley two-phase inductor generators. The power generators give 7,200 alternations per minute, with a voltage which can be regulated from 2,000 to 2,400. An interesting feature is the entire absence of any sort of receiver or air chamber. Notwithstanding the great pressure employed, nearly 500 pounds per square inch, the only protection at present against water hammer is a form of gate which cannot be closed rapidly.

MISCELLANEOUS NOTES.

Is a factory chimney real estate or is it part of the machinery? This question is now engaging the attention of the city assessors of Montreal, on the claim of the Montreal Street Railway Company that their chimney, now assessed as real estate, is really an important part of the mechanical plant, and as such is exempt from taxation. Of the $75,000 expended on the power house of the company fully one-third was used in erecting the chimney. On this point the assessors themselves differ, chimneys being assessed as real estate in some Montreal wards, while they are exempted in others.

The great salt wells at Tsz-Liu-Ching, China, is the title of a recent consular report. In the region mentioned no less than 250,000 persons find employment in operating the 5,000 wells and necessary refining machinery. Most of the wells range from 2,000 to 3,000 ft. in depth. They seem to have been bored with a form of hammer drill supported at the end of bamboo ropes. The work of drilling progresses very slowly, in one case progressing only two inches per day, and a well requires many years to complete. The upper or earth section is usually lined with cedar tubing to keep out surface water. From many of the wells natural gas flows, often under considerable pressure. It is used as a fuel in evaporating off the brine. The brine is raised from the wells by a bucket and windlass, the latter operated by buffalo power.

The London Engineering says: "The French manufacturers of asbestos goods are supplied from four sources: 1. Canada, whence the asbestos is white, silky, very unctuous, having supple fibers from 5 to 25 millimeters in length; of all varieties it is that which spins the most easily. 2. Siberia, whence the mineral is yellowish, some species being of a straw yellow. The fiber is less flexible and more woody, but stronger than the Canadian, which it resembles in length; large masses of long fiber mineral being, however, rarer. 3. The Cape of Good Hope asbestos has a characteristic blue color. It occurs in larger masses than either the Canadian or Russian, and its fiber is generally longer and stronger. In spinning or other manipulation, however, it is difficult to handle, a good deal of the fiber being reduced to powder. 4. In Italy there are different kinds of asbestos, but generally they are little adapted to spinning. There are some long silky fibers of little resistance, employed for gas furnaces; others are very short and fit only to make heat-retaining coverings."

The best aluminum alloys have about 16 per cent. less strength and rigidity when drawn into tube than a steel tube of the same weight and outside diameter; but, owing to its much greater thickness, the aluminum tube can be made of larger diameter without danger of buckling, says Aluminum and Electrolysis. For bicycle handle bars aluminum has greater advantages, and if it could be readily plated it would be really valuable for this purpose. The difficulty of jointing is much against it in most cases. For the comparison of strength and rigidity the tubes tested were both 1 in. outside diameter, and practically of the same weight per foot; the steel tube was 20 gage, or 0·036 in. thick, and the aluminum alloy 12 gage, or 0·110 in. thick. The superiority of the steel tube was due to its greater mean diameter. Making allowance for this, the strength and stiffness of the two materials are nearly equal. The maximum stress in the steel tube was 52 tons per square inch, and in the aluminum alloy, 18·7 tons per square inch. The effect of a brazen heat was to reduce the strength of the steel by 45 per cent., thus bringing down its maximum stress to 28·6 tons per square inch; the stiffness was unaffected.

Talc is extracted on a large scale from the granite mountain of St. Barthelemy, in the French Department of Arriège, about 32 kilometers (20 miles) from the main chain of the Pyrenees. The principal quarry at Tremouin is worked open cast in three banks or terraces, each about 15 meters (49 feet) high. The best rock is of a bright white tint, and feels greasy to the touch when reduced to fine powder. The quarried rock is brought by a tramway to the end of the quarry in the Axiat Valley, and then by wagons for a distance of 19 kilometers (11 miles) to Luzenac, where 90 H. water power is taken from the Arriège River. The mechanical preparation consists of drying in a rotary oven, breaking up small, grinding and sifting, the grinding being effected in mills with steel balls. The larger portion of the product, observes an Ingénieur des Arts et Manufactures, who has communicated these particulars to the Chronique Industrielle, is converted into powder, only a small portion being sent away in the rough state, or cut into pencils for writing on metals. Besides its use throughout most parts of Europe and America, in soap and paper making, talc enters into the composition of wagon axle grease, while it also serves as an insulator for electric conductors.

Consul Morris, of Ghent, under date of September 3, 1897, says: The common council of Courtrai, Belgium, has just voted the exemption from certain taxes for workingmen who build dwellings for their own use. The conditions in brief are: There shall be exempted from the building, paving and sewerage tax: (1) the workingman who, not being an owner of real estate, erects or transforms a building destined to be used by him as a dwelling, and who has secured the property in accordance with certain conditions accorded to workingmen; (2) all societies associated with the Savings Bureau of the Government which erect or transform buildings by one of the methods prescribed by the said bureau, thereby assisting workmen to the ownership of a dwelling house; (3) incorporated associations, organized for a period of at least ten years, which erect buildings destined to be rented to workingmen and which agree in their charter that their dividends shall not exceed 3 per cent. The taxes are payable: (1) If the workingman does not actually occupy this house within three months after it becomes inhabitable; (2) if, before the expiration of five years, he ceases to occupy it or transfers the property to another party not entitled to the exemption; (3) if he establishes in it the sale of liquors. The corporations mentioned must be chartered and must publish their by-laws. If they do not fulfill all details of law, they forfeit their rights to exemption. At Bruges, in 1896, the common council voted the abolition of these same taxes in favor of all properties the annual income of which was less than $27.80.

AUTOMATIC WEAPONS.

THE advantages and disadvantages of the repeating gun have been discussed by specialists for nearly twenty years. Although most armies have hesitated to introduce it, it is not for want of very practical systems, with magazine or loader, permitting of obtaining great rapidity in firing, but rather on account of this very rapidity, which many military men fear as the surest means of depriving them of ammunition before the end of an unimportant battle. According to most officers, the discipline of firing would, only with difficulty, reach such a degree of perfection that it would be possible, at will, to quicken or retard the speed of firing of a troop provided with repeating guns. To-day, either because confidence in the education of troops has increased, or because the great European nations have acted in the matter by simple spirit of imitation, the cause of the rapid fire gun has won.

From the repeating system (rapid in charging, but slow in discharging) one has passed almost everywhere to the gun with a loader into which all the cartridges, generally twelve in number, may be introduced in a few seconds.

There remains only one more step to be taken in order to obtain the possible maximum of firing speed, through the use of the automatic weapon. This latter will perhaps be assailed by means of the arguments that retarded the use of the repeating gun, but there is no doubt that it will triumph over them, for the same reasons. The whole question at present is to know what system will prevail.

Up to the present, two processes have been employed for the maneuver of automatic mitrailleuses. In one (the Maxim) the recoil of the barrel is used for actuating the mechanism, while in the other (recently adopted by the Hotchkiss establishment) it is an escape of gas that serves to effect the motion. This process is older in the portable gun, the one that we are about to describe, and the construction of which is due to the Brothers Clair, of Saint Etienne. Not much studied up to the present as a war gun, this weapon has, nevertheless, reached a high degree of perfection as a sporting piece. It will not call forth the objections urged not long ago against the rapid-fire gun used in the army. In hunting, the inconvenience of finding one's self deprived of ammunition is minimum, and one will scarcely reach the end of his supply of cartridges unless he engages in a genuine massacre. At the most, a sportsman who alone is provided with the new gun will be looked upon with an evil eye by his companions, to whose detriment he will destroy the game.

Fig. 1 gives an idea of the mechanism of the Clair gun. Not far from the edge of the muzzle there is a lateral aperture that gives access to a cylindrical chamber closed by a piston. The latter is mounted upon a hollow rod fixed at the rear to a rod connected with the maneuvering handle of the breech mechanism. Upon the whole, this mechanism is quite similar to that of the Mannlicher gun, with simple motion from front to rear, without a revolving motion for cocking. The mechanism may be actuated by hand either for loading the weapon for the first time, or even during the course of firing; but, normally, it is the escape of gas in front that, acting upon the piston, furnishes the energy necessary for the maneuver.

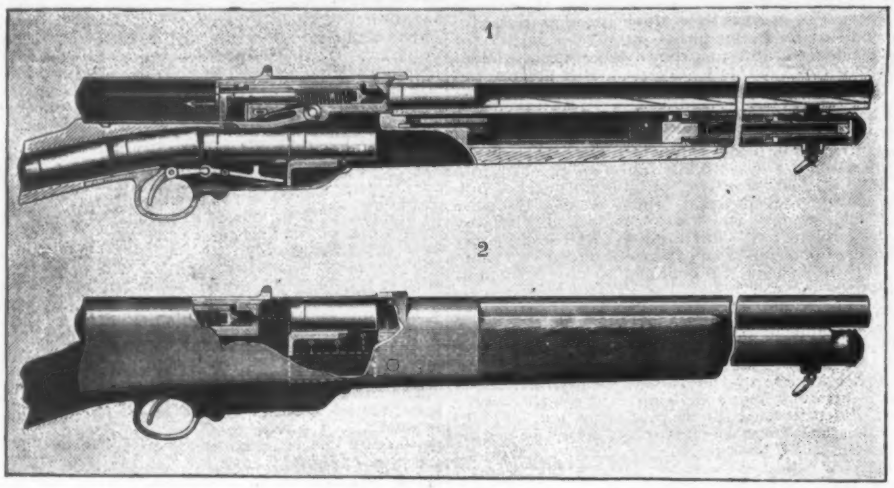


FIG. 1.—THE CLAIR AUTOMATICALLY LOADING GUN.

The piston, after its work is finished, is shoved forward by a spring; the breech closes, and the gun is ready for firing. This motion is extremely rapid. It requires close attention to follow it with the eye, and, in all cases, the gun is ready for firing before the sportsman has had time to raise the trigger and press it anew.

Fig. 3 is an exact reproduction of an instantaneous photograph taken during a firing with the Clair gun. Above the sportsman will be seen the empty shells, which have not had time to fall to the ground in the interval between shots.

If it happens that the sportsman does not wish to make use of the automatic reloading device, it will suffice to remove a screw plug, so as to allow the gas to escape to the exterior and no longer actuate the mechanism. It is almost useless to remark that the piston rod can act upon the breech mechanism only through a thrust, and that it is not carried along in the motion by the hand.

In the sporting gun, the cartridges are introduced one by one into the butt end through the loading aperture situated beneath the breech. The army gun, on the contrary, is provided with a loader.

The second weapon that we shall describe is a repeating pistol invented by M. Borchardt, and that appears to have been submitted to a series of experiments by the German military authorities. This pistol (Fig. 2) is of the type known in France as the mitrailleuse. Like the Maxim gun, the Borchardt pistol operates through the recoil of the barrel, which slides in two grooves that serve as a guide, and shoves backward, by an abrupt motion, a jointed rod of which the pivoting point is situated in the posterior appendage of the weapon.

For the position of the handle, a return has been made to an old form once used in certain fancy weapons. The body of the pistol rests upon this through its center of gravity, thus giving the hand a minimum of effort in firing with extended arm. Such position of the handle, moreover, was indicated by its function. It serves, in fact, as a sheath for the loader, which contains eight cartridges, and which may be replaced instantaneously, when exhausted, by another and full one. This arrangement, furthermore, permits of utilizing the entire length of the weapon for the line of aiming—a very important condition for accuracy in firing. As with the gun above described, the automatic loading may be replaced by a maneuver by hand (Fig. 2, No. 5). The ball, which is of 77 mm. caliber, weighs five grammes. This pistol is a very fine weapon of considerable penetration and great accuracy, and is very usefully completed, especially for war purposes, by arrangements that assure ease of carriage and increase the accuracy of its firing. For a march, it is strapped to a piece of wood in the form of the butt end of a gun, and is inclosed in a leather case to protect it against rain and dust. When it is to be employed, it is unstrapped and used as an ordinary revolver, or affixed to the butt end and used for shoulder firing.

We complete our description in saying that the weapon, suspended on the right side by a shoulder strap, for marching, can be affixed to the butt end in the vicinity of the enemy, so as to be made instantaneously ready for firing.

This new pistol is not only interesting by its ingenious mechanism, its exceptional ballistic qualities, its rapid fire and ease of carriage, for it may be said without any exaggeration that it prepares the way for an evolution in the armament of mounted troops, of artillery of all categories, of military bicyclists, and, in a general way, of all bodies of soldiery whose firing is done only at short or medium distances, and by whom portable firearms are used only exceptionally and to whom they should never prove cumbersome.—La Nature.

FIG. 3.—SPORTSMAN SHOOTING WITH THE CLAIR GUN.

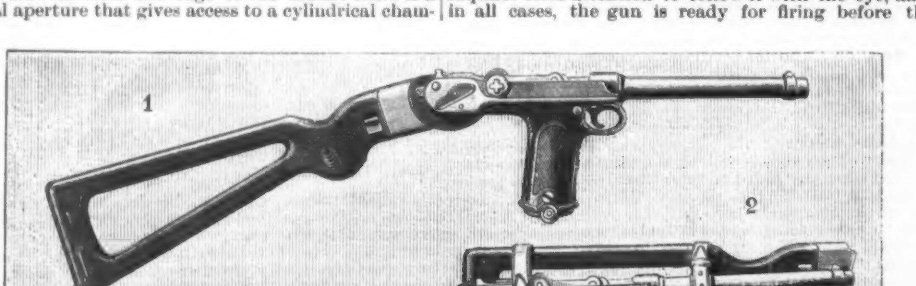


FIG. 2.—THE BORCHARDT AUTOMATIC PISTOL.

The results of some paint tests were exhibited at the October meeting of the Civil Engineers' Society of St. Paul, says the Railway Master Mechanic. Twenty-odd samples were shown of black and more or less rust roughened plates of sheet iron which had undergone six months' exposure to locomotive smoke while suspended from the roof of the Union Depot train shed about 50 feet above the tracks. The iron plates, originally new and bright, had each received one coat of paint and had been subjected to equal exposure. The red lead samples gave the best results, next came the white lead, followed by the iron oxides and the asphaltum, which were generally in much better condition than the graphites. An anti-rust specimen was the brownest specimen of the lot.

ELECTRIC TOWAGE ON CANALS.

The towboats that we have described in a previous article are especially adapted for hauling barges over natural channels. To secure the most economical results, the traction ought to be supplied to the convoys as continuously as possible. This favorable condition is found on rivers either in their natural state or regulated, and usually only interrupted by locks of large dimensions and at long distances apart. But the conditions are very different for the most part on canals, where locks are generally numerous, and not large enough to receive a convoy; the length of the reaches is also, as a rule, very unequal, and under these conditions the haulage of long tows becomes impracticable. Where it is necessary to lock the boats one by one, it is evident that the difficulties of economical haulage in groups become excessive, and for this reason the use of horses has been hitherto found most advantageous, in spite of the numerous experiments in mechanical traction that have been made. The chief obstacle has arisen from the necessity of dividing among a large number of barges the small and independent units of power necessary for each.

The first cost of any such installation must unavoidably be large; and in order to compete with the cheaper horse traction, the expenses of working must be very low. For this reason those systems of mechanical haulage that require the employment of an additional man on each boat involve additional cost, and thus render them inapplicable. Towing by light locomotives running on rails laid upon the canal bank possesses many well-defined advantages, but is attended with other difficulties besides that of excessive cost. It is not a part of the scheme of these articles to consider the relative advantages and drawbacks of the various methods of mechanical haulage on canals; and we refer to them simply as an introduction to a method which has recently been tested on the St. Denis Canal, and which is a modification of the Bovet system, that we have described.

About forty years ago a M. Bouquier suggested a solution to the problem of mechanical traction for canal boats. He proposed to place on board each barge an apparatus consisting of a portable engine driving a paddle wheel by a belt; this wheel was mounted so as to project from one side of the boat. Arrangement was made by which the whole device could be easily shifted from one boat to another, so that a maximum of work could be obtained with one plant. Numerous trials of this system were made, but it was ultimately unsuccessful, on account of the difficulty of transshipping the motor, and the cost of working. M. Bovet has, however, under widely different conditions, followed the lines of Bouquier, substituting an electrical for a mechanical motor. By this arrangement he has reduced the weight of the apparatus to about a ton, which does not appreciably reduce the carrying capacity of the boat. In the arrangement adopted no projection from the boat affects its width, so that the barges can be built as wide as the dimensions of the locks permit; this is an important detail, as it affects the prices charged for carrying freight.

The management of the electric motor is so simple that it can be intrusted to one of the boat's crew, so that no additional charge for wages is incurred. It is evident that electricity is better adapted than any other force for subdivision to actuate small powers, and a part of the current can be utilized for magnetizing the two pulleys. Figs. 1 to 5 indicate the way in which the plan has been experimentally tried on the St. Denis Canal. The barge employed carries about 300 tons, and is of the standard type used on the canals in the north of France. It is an unsightly structure, and offers a maximum resistance to towage. On the other hand, it is cheap to construct and contains the greatest room for stowage; the type is, in fact, one that has been evolved by experience. The towage gear and its motor are inclosed in a sheet iron box, and placed on the forward part of the boat, on a tripod frame, each leg being held by screws to the floor of the barge. The box is free to slide inboard on the frame in passing through locks. The current is brought to the motor from a cable carried on posts along the canal bank, there being a trolley running on the cable. From the trolley passes a flexible cable that extends to a mast on the barge; this cable is led over a pulley, and down the mast, and thence to the towing gear. At the bottom of the mast the cable is wound over a compensating drum, which always preserves a sufficient margin of cable to compensate for deviations in the course; the drum is controlled by a spring that winds up any slack that may have been drawn off.

This means of regulation is necessary, as the mast has usually to be removed in going under bridges, and the cable has to be raised when passing other boats. It has been proved that this arrangement is much more satisfactory than a permanent trolley; not only because it must be placed high enough to clear obstacles met, such as masts, funnels, etc., but also because the trolley cannot be kept to a line over the boat, nor even on one side, as on many of the Brussels tramways, on account of the irregularities in width of water, formation

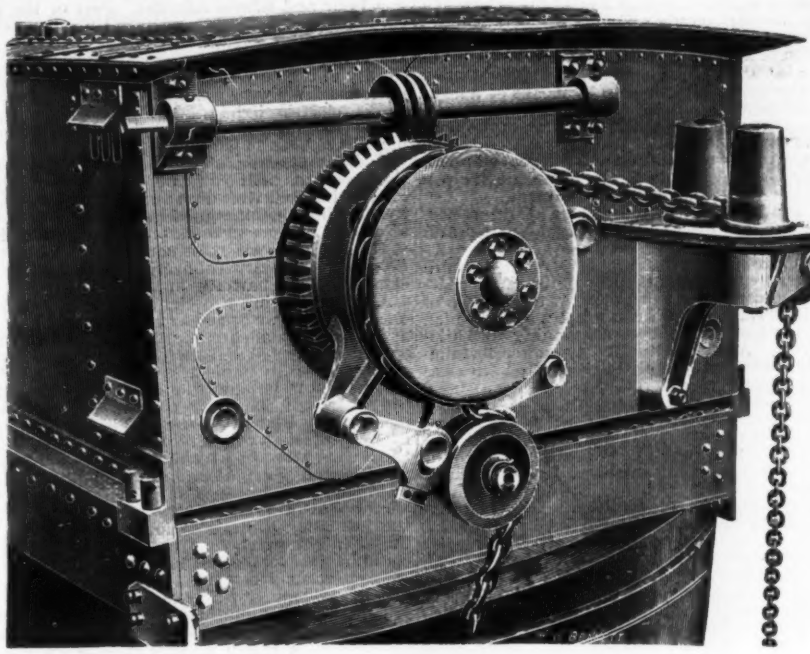


Fig. 6.

Fig. 2.

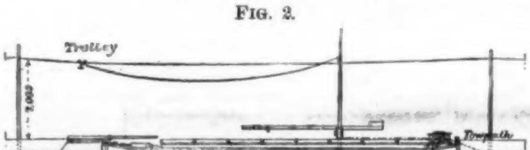


Fig. 3.

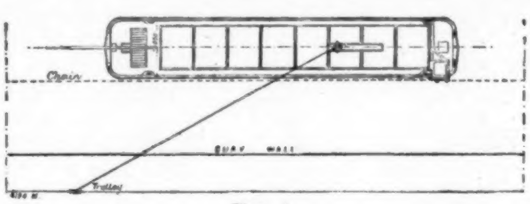


Fig. 4.

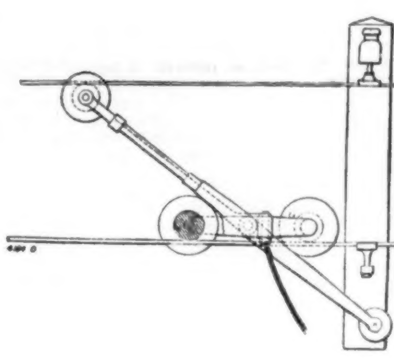


Fig. 5.

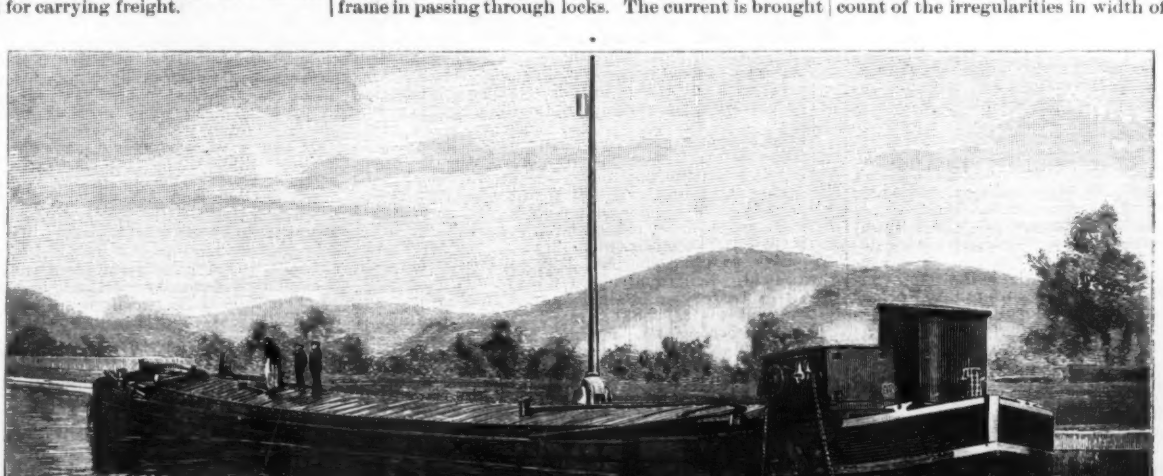


Fig. 1.

ELECTRIC TOWAGE ON CANALS.

of banks, etc. It has not been found practicable to make use of the submerged chain for the return circuit; the resistance is too great. This was clearly proved by the earlier experiments, and it was found necessary that there should be a return cable, and consequently that two trolleys must be used. Those that were first used, and answered well, were made with two deep grooved wheels on a counterweight; one of these trolleys was drawn by the cable and hauled the other. Of course there are various ways of making such trolleys, dependent on the special conditions. One satisfactory form is shown in Fig. 5. It consists of one trolley running on the lower line, and carrying a smaller trolley bearing on the upper cable, either by means of a lever and counterweight or by a spring. This trolley is not liable to derailment, and the man in charge of the boat has only one trolley, instead of two, to look after. The upper trolley can be easily shifted and the boat stopped, or if the way has to be cleared, the whole device can be brought inboard by means of a boat hook.

The tow gear that has been used consists of an electromotor running at 1,000 revolutions, and driving an intermediate shaft by contact between a cast iron fly wheel and a magnetized friction roller; from this countershaft the transmission to the tow pulley is by gearing. The diameter of the tow pulley at the bottom of the groove is 0·40 meter, and the normal speed at which it is driven is 40 revolutions, corresponding to 3 kilometers an hour. As in the Rue Royale sewer installation, already described, the chain rising from the water is guided by a heavy roller, the chain being assisted to leave the magnetized pulley by means of an insulated, or non-magnetic, metal lever. This lever and the guide roller are mounted on an eccentric wheel controlled by an endless screw to regulate the angle of winding round the tow pulley; this can be as much as 270°, or reduced to nothing when it is desired to throw off the chain. Figs. 1 and 6 illustrate the installation very clearly; the latter is an enlarged view of the towing device and the former a general view of the barge fully equipped. It should be mentioned that the wooden shelter shown on the barge was erected to protect the measuring instruments used during the experiments, and does not form any part of the installation. The barge with a load of 300 tons was hauled at a speed of from 2·8 to 3·8 kilometers per hour, with a current of 20 amperes and 110 volts at the station. At starting the current rose to 60 amperes, and then fell gradually, the normal rate being reached when the boat had traversed 80 meters. No difficulty was experienced with steering, in spite of the fact that the tow gear was on one side of the boat, and the trolleys gave no trouble. The conducting cables were needlessly heavy, being adapted for a current of 110 volts; they would have been, of course, much lighter for a 500 volt current. The experimental apparatus we have described and illustrated would be considerably modified for regular service.

The several applications of the Bovet system which are described prove the possibility of utilizing magnetic attraction for the development of considerable efforts; and it may be readily seen that the useful variations of this method may be numerous. In the course of the investigations he has made while pursuing the question of electric towage, M. de Bovet has been led aside in certain important deviations, especially with regard to transmission of power, and magnetic brakes; these have been very fully described in the Transactions of the Société Internationale des Electriciens, of Paris. —Engineering.

RADIUS OF ACTION OF ELECTRIC MOTOR CARRIAGES.*

THE objection that is most frequently raised against the electric motor carriage is "the difficulty of getting it charged." It has come to be the general conclusion among people even well versed in motor vehicle matters that a carriage propelled by electric storage batteries is unable to run beyond a very limited distance from an electric light station. In numerous instances even some of the technical journals devoted to the motor vehicle industry have carefully excluded the electric storage battery from the list of possibly successful motive systems.

So persistent have been these contentions that even in the minds of those who have had actual experience with well-equipped electric motor carriages this question became one of doubt. In no recorded case had any one made an actual trial in a properly constructed electric carriage with a view to definitely ascertaining just where the touring limits of the electric carriage actually lay. It has been the good fortune of the writer recently to make an actual test of this question in one of the Pope Manufacturing Company's Columbia carriages. Although the makers expressly declare the vehicles to be designed for city and suburban service, and do not regard them as adapted to touring purposes, these carriages are fitted with the latest achievements in electrical traction apparatus, and the opportunity for the procuring of valuable information was an exceptional one. The experience, according to the best knowledge of the writer, is the first that has been recorded in which a carriage propelled by an electric storage battery was used for the purpose described.

The start was made from Hartford, Conn., one evening, with the intention of running through to Springfield, Mass., returning the next morning. Stops were to be made at as many towns along the route as was possible, in order to ascertain by experience what might be the actual difficulties, if any, of getting current for charging the storage batteries.

As the Columbia carriages are geared to a fixed speed of twelve miles per hour on a level, no consideration could, of course, be given to the question of speed, although the times of running were noted.

The first town out of Hartford was Windsor. The distance from the starting point was eight miles and the time occupied in making the distance was thirty-five minutes. The roads were in good condition, but quite hilly. The battery indicating meter indicated that 1¼ kilowatt hours of the total of 5 in the batteries had been used.

Upon arriving at Windsor information was asked as to the possibilities of getting electric current for charging the storage batteries. The information received was that the only place available was the works of the Eddy Electric Company, which were closed during the night. We were informed, however, that during the day time current was available at this place.

The journey northward was then continued, the next town being Windsor Locks. The distance from the starting point in Hartford to this place was thirteen miles, and the time occupied in getting there was one hour and fifteen minutes. Part of the road was through very deep and soft sand and numerous bad hills had to be ascended. Upon arriving in Windsor Locks inquiry was again quietly made as to the possibility of obtaining current for charging the storage batteries. We were promptly referred to the Windsor Locks electric light station. This place was found located at the foot of a short hill, the grade of which must have been 15 per cent.

Upon application at the station, it was found that the apparatus used for furnishing the town light was alternating, but that direct current was available from the exciting machines used in exciting the fields of the alternating current generators. The officials in charge of the station were most cordial, and in a very short time the necessary connections were made and the charging of the batteries in progress.

After permitting the charging to go on for about one-half hour, we considered the availability of current at this point adequately demonstrated. The wires were disconnected and we resumed the road northward after successfully navigating the 15 per cent. rise.

It had now become thoroughly dark, and the running through the quiet country in the cool, sweet scented air with the electric headlights of the carriage literally blazing was an experience inspiring to say the least. The almost noiseless action of the electric carriage and the perfection and simplicity of its control made the running seem ideal. Although the road throughout was entirely strange, it was found that the brilliancy of the electric headlights made traveling at night as safe as in the daylight. The road could be seen for at least 100 feet ahead, and the tinge of excitement when running into the dark, wooded districts added materially to the pleasure.

Thompsonville, on the east bank of the Connecticut River, which was crossed on the Enfield Bridge, was the next town reached. It is eight miles from Windsor Locks, and the time taken to make it was forty-two minutes. The roads were in very good condition and only one hill of any magnitude had to be ascended. Upon arriving, information was again asked as to the possibilities of obtaining electricity for charging the storage batteries, and we were at once directed to the Enfield Electric Light and Power Company. The carriage was run to this place, where it was found that Edison direct current apparatus was in use, which could be connected directly to the carriage terminals without any change whatsoever.

Although the people at this station had never before seen a motor carriage, the necessary connections were quickly made and in fifteen minutes the charging was in progress.

After remaining a short time the terminals were again disconnected and, after giving the officials at this station a sample ride about the town, the road for Springfield was again resumed. This road was found to be in excellent condition, but to have very many severe hills. All of the ascents of these hills, however, were made at a smart pace, thanks to the continued freshening the batteries had received, and it is needless to say that, owing to the now late hour, the descents were made at something more than a smart pace. In some places there is no doubt that the speed was fully 35 miles per hour. The road from Thompsonville to Springfield is through a fairly well settled country and is extremely pleasant riding. Springfield is about eight miles distant, and the time occupied in making it was forty-seven minutes. Arriving at Springfield, which has a large and unusually well equipped and regulated electric light station, we proceeded at once to the latter place. It was found here that alternating apparatus was the principal one used, and that, as at Windsor Locks, it was necessary to get the current from the exciting machines. Through the courtesy of the management, this was soon arranged, however, and the carriage was shortly being charged. At this place the battery indicator indicated three spaces of the five on the battery indicator as used. As it was desired to run about the city of Springfield in the morning before returning to Hartford, the batteries were charged until the indicating finger had returned completely to the "full" position. Having returned to this point, we departed for the Massasoit Hotel. Arriving here, we went through the ordinary procedure at the stable precisely as though we had an ordinary horse and carriage. Instructions were left with the stable keeper to wash the carriage in the morning, precisely as he would any other carriage.

In the morning, after breakfasting and listening to the interested talk of numerous people who had seen the carriage on the previous evening, we repaired to the stable and found everything in perfect condition. We then visited numerous places in the city, giving different people short rides, and at 9:30 we started on the return to Thompsonville.

Thanks to our generous dispensation of rides in Springfield, when about two miles out of Thompsonville the battery indicator showed that almost the entire contents of the battery had been consumed. On the arrival of the carriage at the electric light station in Thompsonville it was noted that the carriage was rapidly slowing down, although it was very plain that the batteries were still "willing." This characteristic of the electric storage battery to respond even to the most abusive loads is one of its most useful peculiarities, which, when understood, gives it a warm place in the heart of the motor carriage driver, and insures the electric carriage a permanent place in those fields where its limited radius of action is of small importance. Not until the last bit of current has been removed will it yield, and even then, after a short rest, it makes an effort to do one's bidding. A good storage battery is like a good dog.

The batteries were completely filled at Thompsonville. The return trip over the road to Windsor Locks was a very rapid and most enjoyable one, and owing to the daylight and the publicity of the occasion, considerable excitement was caused along the road. Although carriages equipped with other kinds of power have passed along this road in the past, the fact that this was the first "motor voiture de luxe" prevented any diminution in the interest shown. Windsor Locks was passed at a good twelve-mile gait and Windsor reached without a stop from the time we left the electric light station at Thompsonville. The distance between the two places is between twelve and fourteen miles and the time occupied in making it was one hour and five minutes.

A short stop was made at the Eddy Electric Company, through the courtesy of whom we were able to carry out our intention to ascertain officially the availability of current on subsequent trips through Windsor and to make a specimen charge, after which the return trip was resumed. The works of the Eddy company are eight miles from the place where the carriage is kept at Hartford, and the time occupied in making the run was forty minutes. The arrival home completed what is probably the first country trip of any electric carriage, the use of which, it is now apparent, is in some localities in fields beyond those to which its essential peculiarities ordinarily confine it. The makers of the Columbia carriages issue with their vehicles an interesting little pamphlet giving such information as is necessary to extend this field to the utmost, including a list of the principal charging stations in some of the Middle and Eastern States.

It was found on the trip that the cost of electric current at the different electric light stations was such as to make the cost of running between 1¼ and 2 cents per mile. In the smaller country stations the charges are high, but in the large cities the charges are such as to make the cost of running comparable with those of gasoline carriages. Six cents per kilowatt hour is the average price charged at large stations, resulting in a cost per mile of 1¼ cents.

To ascertain the ability to make an extended tour in the Eastern States, an examination into the location of the different electric light stations was made by the writer. The results of this investigation indicated that, starting from, for instance, Hartford, current could be obtained at intervals which would enable an electric carriage to easily run to Boston. Current is obtainable at Thompsonville, Conn.; Springfield, Mass., which is twenty-nine miles from Hartford; Palmer, which is sixteen miles from Springfield; Warren, which is eleven miles from Palmer; South Spencer, which is eleven miles from Warren; Worcester, which is seventeen miles from South Spencer; Westboro, which is thirteen miles from Worcester; South Framingham, which is ten miles from Westboro; Wellesley, which is seven miles from South Framingham; Newton, which is eight miles from Wellesley; and Boston, which is seven miles from Newton. Of course, there would be no need of stopping at all these stations, as the batteries in the Columbia carriage are good for twenty-five miles on ordinary country roads.

In the first part of the eastward trip from Springfield the roads are very hilly and sandy, and it is probable that the mileage of the batteries here would not be greater than twenty; but, even so, it is seen that electric light facilities are ample.

Going westward from Hartford, it was found that electric light stations where current is available are located at New Britain, ten miles from Hartford; Meriden, ten miles from New Britain; New Haven, nineteen miles from Meriden, but between which there are large mills using electric lights and willing to sell it to carriage users; Naugatuck, which is thirteen miles from New Haven; Bridgeport, which is five miles from Naugatuck; South Norwalk, which is fourteen miles from Bridgeport; Stamford, which is eight miles from South Norwalk; Port Chester which is eight miles from Stamford; Mamaroneck, which is five miles from Port Chester; Mount Vernon, which is seven miles from Mamaroneck; and Forty-second Street, New York City, which is fourteen miles from Mount Vernon. In New York current is available in almost any locality, even at many private residences.

In running out of New York it is found that the electric light stations up the Hudson River toward Albany are at near enough intervals to make touring also possible, and the same is the case between New York and Philadelphia. In the vicinity of Philadelphia the facilities are not quite so good in all directions, although the most enjoyable trips are in the direction in which electric current is available.

The only disadvantage that can be connected with the charging of storage batteries is the time required. In recharging mechanical carriages it is, of course, merely necessary to obtain the fuel. In the case of an electric carriage, however, a certain amount of time is necessary. In no case, however, unless the batteries are completely discharged or empty, is it necessary to take more than one and one-half hours. In many instances in the experience of the writer, the current consumed in a run of twenty miles has been returned in one and one-half hours.

Of course, at the present time the best recharging facilities exist in the Eastern States. It is probable, however, that even in the Middle-Western States the distances between stations where current can be purchased is so small that touring is possible whenever the condition of the roads would permit.

In this connection, and in conclusion, it may be interesting to state the number of towns and cities in the different Eastern and Middle States that have regularly equipped electric light stations. The following is a list:

Maine	30	New Hampshire	35
Vermont	23	Massachusetts	99
Rhode Island	12	Connecticut	34
New York	183	New Jersey	61
Pennsylvania	199	Delaware	5
Maryland	21	District of Columbia	2
Virginia	37	West Virginia	21
Ohio	133	Michigan	117
Indiana	96	Illinois	197
Kentucky	37	Iowa	106

* By Hiram Percy Maxim, in the Horseless Age.

A report of the United States Geological Survey states that coal getting machines are now being used to a greater or lesser extent in fifteen of the States. In 1896 the coal mined in these States by machinery amounted to 12,353,522 tons, or 13 per cent. of the aggregate output of those States for the year. The use of machines is likely to increase where they can be adopted with advantage.

BEESWAX ASSAY.

WAX analysis is not difficult, though unfortunately somewhat tedious, since no single test is available by which you are able to say that it is pure beeswax.

Beeswax is an important pharmaceutical substance, and also is extensively used in the arts.

Beeswax has, like that closely allied class of substances, the fixed oils, been the successful subject of the adulterator. Formerly it was largely adulterated with simple substances, such as flour, earthy matter, ferric oxide, etc. These still can often be found in wax, but are due as a rule to imperfect collection, and not as adulterations and makeweights. For the purpose of adulterating wax these obviously apparent admixtures have been supplanted to a large extent by use of other waxes so closely allied to the true beeswax that it now requires a careful and accurate analysis to detect them, identification often being impossible.

The Melting Point.—Different methods for the determination of this most important factor have from time to time been described, often one only being a modification of another.

The pharmacopœial method is naturally one which comes before us most prominently; the details given in the B. P. are familiar to all, and therefore need no explanation. The B. P., however, does not describe it quite accurately enough, for no mention is made of the fact that the melting point should not be determined until some hours have elapsed after the wax has been drawn into the capillary tube. This is a most important detail, for recently melted wax will remelt at a much lower temperature, and consequently you will obtain a lower result than is really the case.

The best way to determine this point by the capillary tube process is to work upon the lines indicated by the Hungarian Society of Analysts. They direct that the wax should be drawn up into a long capillary glass tube; seal the lower end, and attach it to the bulb of the thermometer in the usual way, so that the column of wax corresponds to the bulb of mercury. After twenty-four hours, place the thermometer into a glass test tube filled with glycerin and heat very gradually.

By observing details like these in such a test, the results are sure to be more reliable and comparable.

Pohl's process is a simple one, and yields very concordant results. The bulb of the thermometer is dipped into melted wax, so as to obtain a film of wax, then the instrument is fixed in a long clear glass test tube. After allowing the wax to become properly "set," which generally requires at least six hours, heat gradually by holding the tube containing the thermometer over a thick iron plate heated in the usual manner. The moment the wax forms a drop on the end of the bulb of the thermometer, note the temperature, which is the melting point.

Redwood proposes a modification of this method. Instead of placing the wax on the thermometer he lets melted wax (a small quantity) fall upon some mercury contained in a dish to which is attached a thermometer. Apply heat gradually, and the moment the wax disperses as a film observe the temperature, which is the melting point.

Specific Gravity.—For the determination of this essential point there are many various processes employed, but the majority of them depend on the use of special apparatus, generally of a most costly description, so there is no need to refer to them. On the other hand, there are several useful and accurate methods which can be employed without the expense of such appliances.

Hager's Process.—The essential feature of this method is to find the specific gravity of the liquid in which the wax will remain suspended in equilibrium.

The method of working this process is a simple one. Melt the wax gently and allow it to fall from a moderate height into some alcohol, 70 per cent. With practice a large number of beads of wax are formed.

These, after allowing time for contraction to occur, are placed in some previously diluted alcohol. To this either a stronger or weaker alcohol is added, until the beads are suspended in equilibrium at 15·5° C.

It is essential that the beads should be fully contracted, for from Dieterich's experiments it is shown that a very considerable error may arise by using the wax too soon after it has melted.

In consequence of this possible error, Chattaway and Allen prefer to cut the wax into small cubes and brush them over with a wet brush before immersion, to prevent the adhesion of air bubbles.

The specific gravity of the wax is therefore the specific gravity of this liquid, which can be determined in the usual manner.

According to Proctor, 100 grains of wax, with a five grain weight stuck in it, should sink in water, but should float with a three grain weight.

Solubility.—The solubility of a wax should also be taken into consideration. It is soluble in ether at 22° C. Insoluble in cold but completely soluble in boiling alcohol. Chloroform dissolves out about 25 per cent. in the cold, but completely dissolves it when hot.

CHEMICAL TESTS.

Determination of the Free Acids.—Beeswax contains cerotic acid, which is soluble in boiling alcohol, and is capable of being neutralized by an alkali. Advantage of this fact is taken by analysts in determining the purity of wax, since about 12 to 16 per cent. of cerotic acid is invariably present. If the wax were always pure, it would be a simple matter to calculate the amount of this acid, but as it is so frequently adulterated with other substances containing a free acid, the result of this test is generally referred to as the number of milligrammes of KOH necessary to neutralize the free acids in one gramme of wax. This is called "the free acid value."

Saponification Value (Koettstorfer's Number).—The second of the great chemical tests for wax is the saponification value, which is the measure of the amount of alkali—KOH—required to completely saponify the whole of the wax. In the previous case only the acid soluble in hot alcohol was estimated, but in this case the insoluble portion—myricin—is also estimated. The ester myricin or myricin-palmitate is not saponified by an aqueous solution of potash, the reaction only occurring in alcoholic solution.

The ester value indicates the number of milligrammes of $\frac{KOH}{N}$ required to saponify the neutral esters in one gramme of wax. In obtaining the acid value that portion of wax soluble in hot alcohol was estimated—cerotic acid. In obtaining the saponification value the insoluble as well as the soluble bodies were conjointly estimated—cerotic acid and myricin—provided, that is, the wax was pure.

It is evident, therefore, that the ester value is the difference between the acid value and the saponification value, or, in other words, the saponification value is the sum of the acid and ester values.

In practice the easiest way to obtain these figures is to first ascertain the acid value, and then add the alcoholic alkali and proceed as described under saponification value. Then the amount of alcoholic KOH used corresponds to the ester value, and the total alkali, both aqueous and alcoholic, is necessarily the saponification value.

IODINE AND BROMINE NUMBERS.

Whether pure beeswax does absorb any appreciable quantity of the halogen is a somewhat doubtful point. Most of the great workers on this subject do not refer to this test, while a few give a very low and variable figure, that may, I think, be disregarded. These tests are most valuable when regarded from a negative standpoint. Pure beeswax, we may take for granted, absorbs little iodine and bromine, while, on the other hand, several of its most frequent adulterants do absorb a large amount, more especially carnauba wax and tallow.

Resin is frequently referred to by the authorities on this subject as a favorite adulterant, but as far as my experience teaches me, it is not generally used at the present time, except in prepared waxes for technical purposes.

Like stearic acid, it is apt to alter the specific gravity, making it considerably higher. Resin specific gravity = 1·045, 1·108, Lewkowitsch. It also gives a higher acid value unless compensated. If suspected it can be isolated conveniently by boiling the wax in 50 per cent. alcohol; filtering when cold, and evaporating the filtrate to dryness, and weighing the product. By using weak alcohol, stearic acid is not extracted.

It is obvious, therefore, that, though these processes are of great utility in analyzing beeswax, the results are not altogether conclusive. Every sample should be boiled with alcohol; when cold, filtered and an equal volume of water added to one part and an equal volume of solution of chloride of calcium to another. In each case the solution should remain bright and clear, precipitates indicating the presence of Japan wax, resin, tallow, etc.

In addition to these two tests, the wax of doubtful character should be submitted to the halogen test; absorption of either iodine or bromine at once points to the presence of a foreign body, most probably carnauba wax, tallow, or resin.—Read at meeting of Chemists' Assistants' Association.

INTERNATIONAL METEOROLOGICAL CONFERENCES.*

By ROBERT H. SCOTT, M.A., F.R.S., Secretary to the International Meteorological Committee.

THERE is no science so dependent on international concord for its successful prosecution as meteorology; and, consequently, for nearly half a century past such meetings as that which has recently taken place in Paris have from time to time been held.

The first and most famous of these assemblies had reference exclusively to maritime meteorology. It was held in 1853, in Brussels, mainly at the instigation of the late Commander M. F. Maury. Out of that congress grew a system of meteorological observations at sea, to be carried out in a uniform manner by all the nations represented at the congress. The form in which the observations were to be recorded is known as the "Brussels Abstract Log."

Looking back, in 1896, to the ideas of 1853, and to the fulfillment which has been made good in the space of forty-three years, the first matter calling for notice is that the United States, which took the initiative in convening the first congress, have completely given up their co-operation in the work of recent years, and are devoting themselves entirely to the preparation and issue of pilot charts.

Only three nations have continued to work up, with more or less fidelity, to the standard sketched out at Brussels—Holland, Germany and this country; each of which has produced contributions, of more or less extent and value, to our knowledge of the meteorology of the ocean.

Our own meteorological department of the Board of Trade, under Admiral Fitz-Roy, took its rise out of the Brussels congress. It was founded in 1854. In a letter from the president and council of the Royal Society, dated February 22, 1855, which has repeatedly been reprinted, we find that it was then contemplated that the meteorology of the entire ocean might be ascertained with a considerable approach to accuracy, by the organization then called into being. The impossibility of carrying out these wishes was not then fully realized.

After the Brussels meeting, matters, as regards international meteorology, slept for nineteen years. In 1872 an invitation to a free unofficial meeting at Leipzig was issued by three eminent meteorologists—Dr. Carl Bruhns, Observatory, Leipzig; Dr. Carl Jelinek, Meteorological Institute, Vienna; and Dr. Henry Wild, director of the Central Physical Observatory, St. Petersburg.

This conference was attended by fifty-two persons, representing most of the states of Europe, and inter alia it passed a resolution recommending the establishment of special offices for maritime meteorology in all countries where the requirements of navigation called for such a measure.

Out of the conference of Leipzig, the congress of Vienna, 1873, arose. This was summoned through diplomatic channels. There were thirty-two delegates present. As regards maritime meteorology it simply confirmed the resolutions of Leipzig, and further recommended the convening of a conference in London, for the discussion of the subject of maritime meteorology. This conference was held from August 31 to September 2, 1874, and was attended by twenty-four persons. Its deliberations were mainly directed to the discussion of the Brussels Abstract Log, and of the methods for reduction and publication of the observations.

Four years elapsed, and in 1878 a report on maritime meteorology* was drawn up for presentation to the projected meteorological congress at Rome. This report was published by the meteorological council, and it contains, in the several answers to a circular of questions issued in 1877, a very complete résumé of the arrangements for the prosecution of ocean meteorology in the various countries of Europe and in the United States. The replies from Commodore Wyman, Hydrographer to the United States, from Capt. Empis, representing the Ministère de la Marine, Paris, and from Sir F. J. Evans, K.C.B., Hydrographer to the Admiralty, were particularly detailed and instructive.

The congress of Rome, 1879, was fully official, like that of Vienna, six years previously. It was attended by forty persons. Its action, as regards maritime meteorology, consisted in expressing its satisfaction with the mutual understanding which had been the outcome of the London meeting, and its opinion that perfect liberty should be left to the nations interested in making mutual arrangements for the prosecution of their work.

Since 1879, no congress has been held. The absurdity of summoning duly accredited representatives of governments, who were charged to announce to their colleagues that the authorities at home refused to be bound by congress resolutions, was apparent. The subsequent meetings of Munich, 1891, and of Paris, 1896, have not been official—in other words, they have not been brought together through diplomatic channels, but have been collected by circulars addressed to the heads of the meteorological services in the different countries.

At Munich, in 1891, the only mention of maritime meteorology was a request that methods of discussion and of publication of results should be uniform all over the world. Compliance with this demand was recognized as impossible, owing to the admitted inequality of distribution of material in the different oceans.

We now come to the conference of Paris in September last. At this no person, except Lieut. Kesslitz, from Pola, represented an exclusively marine establishment. Mr. James Page came from the Hydrographic Office, Washington, but only in a private capacity, not as representing his office. The questions which had direct reference to the sea, and which were brought up for discussion at the meetings, were few in number.

The first was a proposal from Dr. Paul Schreiber, the director of the meteorological service of Saxony, for the development and multiplication of observations of sea surface temperature over the North Atlantic. Dr. Schreiber gave no suggestions as to carrying out his proposal, and so the conference contented itself with recognizing the desirability of its realization.

Dr. Biese, of Helsingfors, head of the meteorological service of Finland, requested the conference to pass a resolution supporting his efforts to create a department for hydrography and maritime meteorology in Finland. The conference decided that in the case of Dr. Biese's request, and other similar proposals, inasmuch as the meeting had no official status, it was not in its province to pass any resolution which might in any way suggest a course of action to any government. It therefore placed on record its sense of the importance of the objects which Dr. Biese and others sought to attain.

More than one gentleman sent requests to the conference to institute investigations into the origin and phenomena of cyclones, but it was fairly remarked that it would not be an easy task to moor a cyclone to one spot, so as to allow of time for instituting observations all round its center!

Dr. Paulsen, chief of the Danish meteorological service, produced a series of very interesting charts, showing the monthly distribution of floe ice in the North Atlantic. The information from Greenland and Iceland is collected from Danish vessels making passages to those colonies; for the sea northward toward Spitzbergen it is furnished by Norwegian whalers. Dr. Paulsen requested any gentlemen who had access to observations from the North Atlantic, north of the sixtieth parallel, to send these data to Copenhagen for the completion of his charts.

Mr. C. L. Wragge, of Brisbane, head of the meteorological service of Queensland, brought forward various propositions relative to the importance of securing observations from high southern latitudes. The desirability of procuring such information was recognized as incontestable, but no opinion was expressed as to its practicability.

Dr. Snellen, director of the Meteorological Institute of the Netherlands, proposed a resolution of a very general character, which was adopted by the conference, to the effect that it was desirable that a special conference be called together to discuss the subject of maritime meteorology. No definite programme of subjects for discussion at this conference, if it ever comes to pass, has yet been put forward.

In this connection we must notice a paper which was prepared for submission to the Paris conference by Dr. G. Neumayer, the Director of the Deutsche Seewarte in Hamburg. Dr. Neumayer is well entitled to speak with authority on the subject; for more than forty years ago he was working at the Flagstaff Observatory, Melbourne, on the meteorology especially of the Southern Indian Ocean, on the track of the Australian trade. In the paper now under consideration he gives a masterly summary of the condition of the science at present all over the civilized world, and expresses his hopes that uniformity of methods, etc., may be introduced, but without making any practical suggestions as to how the object can be attained. The great point which Dr. Neumayer urges is the necessity for a more or less free interchange of material between the different offices.

The difficulty in carrying this out lies in the expense involved in such a communication of information. It is universally admitted that the original logs cannot be handed about from office to office. Copies must be made, and the cost of copying soons grows to be over

* Nautical Magazine.

* Reports to the permanent committee of the first international congress of Vienna on atmospheric electricity, maritime meteorology and weather telegraphy. Published by authority of the Meteorological Council, London. Eyre & Spottiswoode, 1878.

whelming, for observations are required by tens and even hundreds of thousands.

The great difficulty of carrying out the idea conveyed in the letter from the Royal Society, already mentioned—that of publishing data for the entire sea surface—is at once evident when we consider that, in order to get observations, we must have ships, and ships will only be found along trade routes.

In the higher latitudes of both hemispheres the area from which materials are obtainable is strictly limited by the boundaries of ice prevalence.

In the South Atlantic Ocean observations are excessively rare from any parts except the belts marked by the tracks, outward and homeward, to and from the capes. In the Indian Ocean it is all but impossible to find observations for the vast region lying off the northwest coast of Australia.

As for the Pacific Ocean, no single part of it is covered with observations at all so thickly as even the less frequented parts of the other oceans.

We see, therefore, how much requires to be done before the meteorology of the sea can be held to have been thoroughly investigated.

As regards the proposal for a new conference, neither Dr. Neumayer nor Dr. Snellen has put forward a distinct programme, and without such a series of questions it is not easy to see how an invitation to a meeting has much chance of a favorable reception.

As regards the desirable uniformity of methods, the suggestions for work differ very widely. A few years ago an eminent Russian officer, Rear Admiral Makaroff, published the results of his observations in his ship, the Vitiaz, in the Pacific Ocean. In that volume he suggested far minuter work than has ever been attempted elsewhere. He asks that the actual day of the month on which an observation is taken should be stated, so as to show how the figures are affected by the season of the year!

In direct contrast to such nicety is the work turned out by the Hydrographic Office, Washington. This consists of pilot charts for each month, which fall out of date in a few weeks, and which Dr. Neumayer fairly describes as being ephemeral in character.

In conclusion, we regret that we are not able to say more than that the action of the Paris conference, as regards maritime meteorology, consisted in the registration of a certain number of good resolutions, without making any practical suggestions as to the methods for carrying them out.

THE CANOES OF THE MENOMINI INDIANS.

In the first part of the Fourteenth Annual Report of the Bureau of Ethnology to the Secretary of the Smithsonian Institution, 1892-1893, there is a very interesting and important monograph entitled "The Menomini Indians," by Walter James Hoffman, M.D. By the courtesy of the director of the Bureau of Ethnology we are enabled to present an engraving showing the setting up of a bark canoe, and our text is extracted from Dr. Hoffman's monograph.

The attention of some Menomini shamans who visited Washington was attracted by the work of the Bureau of Ethnology, and after protracted conferences the pro-sition was made by the chief, Niopet, that a visit to eir reservation at Keshena, Wis., be made; that, after oper instruction by some shamans to be appointed, d due initiation into their society termed the Mitä-t, their version of the traditions and dramatized ms of initiation should be studied, so that it could preserved for the information of future generations the Menomini. The first visit was made to Keshena 1890, followed by four subsequent visits to attend to necessary instructions and ceremonials of the iety. It was during these visits that other new and eresting facts were obtained—material relating to ir mythology, social organization and government customs, industries and linguistic germane to the subject in general. Space forbids even an outline of the interesting facts which are recorded in Dr. Hoffman's monograph.

The fabrication of Indian canoes is very interesting. The Menomini have almost entirely discontinued the making of the simple dugout and the birch bark canoe, and even among the old men but few are now recognized as having in their day been experts in this industrial art. The simpler form of boat was the dugout made of a single trunk, preferably that of a butternut tree. The wood is much heavier than most others available, but the Indians believe it resists better than any other variety the effects of long contact with water, as well as the erosion to which the bottom is subjected by frequent rowing in shallow streams in beds of gravel or bowlders.

The birch bark canoe is by far the most graceful piece of mechanism produced by the Menomini. The general form of the canoe differs to some extent among the various northern tribes. The type of canoe made by the Menomini resembles that of the Ojibwa, of Wisconsin, who are their nearest northern neighbors and with whom they have for many years maintained friendly relations, and to some extent intermarried. For their manufacture large birch trees that appear to furnish the best bark are selected and the pieces are cut as large as possible. These sections are sewed together with threads made of the long, thin roots of a species of spruce, a material durable and well adapted to a constant wetting.

The framework of the bark canoe is made of white cedar, which is durable, light and elastic. The ribs are thinned with a drawing knife, and when the required number have been made they are curved according to the parts of the canoe which they are intended to brace—the middle, of course, being much more distended laterally, while the ends gradually narrow to a point.

The tops of the ribs are held in place by being tied to a cross piece, the ribs and cross piece thus resembling a bow and its string. Then the entire series of ribs is fastened by tying to the longitudinal strips, corresponding to the gunwale, thus setting up the skeleton, as it were. These strips also are cut to the required thickness by means of a draw knife.

When the framework has reached this stage the bark, which in the meantime has been stitched together, is laid on the ground, the framework placed upon it, and then the bark is turned up over the sides; short posts are driven into the ground, all around the canoe, to hold the outside strips, to reinforce the edge or gunwale, and to prevent the breaking of the bark at the end. The appearance of the work at this stage is shown in our engraving. All the necessary stitching is then done to hold the tightly secured bark in place. The bow and the stern are still sufficiently unlike for the Indian to note which is the bow, for that end of the canoe, as in the dugout, is usually a little broader across the shoulders. The bottom of the canoe is lined with thin slats or shingles to protect the delicate bark from being broken. The seams, small punctures and knot holes are then sealed with pine resin.

Although the women have many duties to perform in connection with the building of a canoe—such as cord spinning, the stitching together of the pieces of bark and the final lashing of the long pieces forming the gunwale—the men usually do all the paddling when the canoes are in use.

The paddle is made of cedar or some other light wood. It measures about four feet in length, of which nearly one-half is devoted to the blade, which varies from four to six inches in width. Generally the top of the handle has two projecting pieces resembling a letter T, giving the oarsman an easy and effective means of holding and using the paddle. When not in use, the canoe is always pulled ashore and turned over, in order to allow the bottom to dry.

MENOMINI INDIANS SETTING UP A BARK CANOE.

SIGNORA ZEFTHE AHAIRA.

SIGNORA ZEFTHE AHAIRA.

On October 18, Prof. Dr. Haberda, the Instructor of Medical Jurisprudence at the Vienna University, brought into his clinic one who appeared to be a small man with a heavy beard and mustache, and the students were greatly surprised to learn that this person was really a woman, although her strongly marked countenance, with its beard, her manner and bearing, and even her voice, were most masculine. Signora Zefthe Ahaira is thirty-three years old and was born in Tunis of Italian parents. She is the sixth in a family of fifteen children and the only one that developed any abnormality. She did not remain long in the convent in which she was to have been educated. At the age of fifteen she married and gave birth to a normal child, which, however, did not live long. As she and her husband were not happy together, they were soon divorced. Before her marriage, and while she lived with her husband, she kept her beard shaved, so that her appearance would not attract attention; but as the constant shaving became burdensome, she decided to let it grow and to adopt men's clothing, which she has worn uninterruptedly for a number of years, with the permission of the Italian authorities. She has conducted herself so like a man that no one suspected her of belonging to the "weaker sex," the impression thus conveyed being intensified by the manly tones of her voice. Prof. Haberda considers her a remarkable specimen of hermaphroditic formation. She is going to make a tour of Europe and America to give specialists a chance to study her.—Illustrirte Zeitung.

Cement pipes are made cheaply by an ingenious process devised by a French inventor. A trench is dug and the bottom filled with cement mortar. On this is placed a rubber tube covered with canvas and inflated; the trench is then filled up with cement. As soon as this is set the air is let out of the rubber tube, which is then removed and used again in another section. By this method six-inch pipes have been made at a cost of twenty-two cents a yard.

ACANTHOPANAX SESSILIFLORUM.*

ALTHOUGH, as the references show, this cannot be considered a new plant even in gardens, yet it is comparatively little known. We met with it in fruit lately in the nursery of M. Lemoine, at Nancy, and with the predatory instinct of the botanist, secured a specimen for the benefit of the readers of this journal. It is a handsome shrub, presumably perfectly hardy, with long stalked, palmately three-lobed leaves, the lobes leathery, dark green, broadly lanceolate, and tapering at each end, finely serrate at the margins. The flowers, which we did not see, are in globose heads, and are succeeded by black berries, each the size of a small pea, and reminding one of privet berries, or still more of ivy berries. The shrub is a native of the Amoor region, of the coast of Manchuria, and of North China. —The Gardeners' Chronicle.

ACANTHOPANAX SESSILIFLORUM—BERRIES LUSTROUS BLACK.

A NATURALIST'S SOJOURN IN THE CRATER OF MAUNA LOA.

WHEN, at noon on August 8, I stood alone at the edge of the crater of Mokuaweoweo, my feelings were of a somewhat mixed character, says Dr. H. B. Guppy, of Hawaii, in the Pacific Commercial Advertiser. I had just said good-by to Mr. John Gaspar, who had brought me up, and before me lay a period of solitude of three weeks or more. From a previous ascent made on April 1, I gathered that it would be very cold, but beyond this I knew nothing of the climatic conditions to which I would be exposed. However, I set to work at once to arrange the interior of my tent, got out my meteorological instruments and planned my examination of the crater.

Before many days had passed it became apparent that the conditions of my existence were not unlike some of those to be found in the moon. In the complete sterility of the surface, in the very existence of the grim old crater, at the edge of which I had pitched my tent, in the rarefication of the atmosphere, in the intense dryness of the air, as indicated by observations on the relative humidity; in the prevailing cloudless sky by day and in the clear starlit calm and dewless nights; in the severe cold at night and in the scorching of the sun in the day, there were produced many of the conditions we would look for in that planet. Then, again, the air at first was highly electrified. My red blanket crackled under my hands at night and I could trace on its surface in phosphorescent hues with my fingernail the letter A as I lay completely enveloped in its folds. The detached wings of dead butterflies picked up from the ground adhered provokingly to my fingers, and I began to imagine myself an electric battery. The effects of these meteorological conditions soon showed themselves in the cessation of the action of the skin, in severe headaches and sore throat; in a tendency to palpitation and dyspnœa, and in sleeplessness, general lassitude and loss of appetite, most of which symptoms I attributed to the great lack of moisture in the air. I began seriously to think that Mr. Gaspar would find a mummy on his return, when a short spell of damp weather intervened, and, most of the unpleasant symptoms having disappeared, I began to take more interest in my surroundings.

And soon I found that I had a regular visitor twice a day in the shadow of the long mountain. For about twenty minutes after sunrise and before sunset the shadow of the mountain was thrown back against the sky of the opposite horizon. It seemed as if some Titanic brush had been at work on the sky far away, and had worked in the profile of the mountain with a very uncanny blue. Most evenings I used to light my pipe and watch the arrival and disappearance of the old mountain's shade. The peak was the last to go, and that was the signal for my retiring for the night. I was in the habit of getting up three or four times in the night to make observations of the wind and weather. A 1 A. M. on August 9 there was a most beautiful lunar halo, displaying most of the rainbow hues, the purple inside and the orange outside being most conspicuous. This was repeated in a less marked degree in the following night, and after that the phenomenon disappeared.

During my sojourn on the mountain top there was very little rain, only about 30-100 of an inch. Most of the rain on the summit fell during the night of August 12–13, and in that night I had an uncomfortable time of it. The wind was very gusty and was apparently disposed to lift up my tent and carry it bodily into the crater. It was bitterly cold, and I lay down with my boots on, lit my pipe and prepared for the worst. The canvas was reeking with the wet, and every fresh gust of the biting norther seemed to promise to deprive me of my shelter. Nature, however, came to my aid.

After sunset it began to freeze hard, and before long the canvas of my tent was as stiff as a board and no longer swayed to and fro with each gust of wind. I then fell asleep for an hour or two, and woke up to find the wind blowing strong from the south. A rapid thaw had set in, and the canvas was again soaking with wet, the water running down on my stores. This was repeated during the night, and to vary the entertainment there were two earth tremors, lasting in each case a few seconds. My tent, however, held bravely on. Sleep came to me in the early morning, and when I woke the sun was high up and there was a genial warmth in the tent.

The cloud effects were often magnificent. The snow-white sea of cumuli that gathered in the forenoon round the mountain slopes usually concealed the Kohala Mountains, but as a rule failed to hide the summit of Hualalai, and probably the level of its upper limit is on the average between 6,000 and 7,000 feet. Except on the few occasions when there were rain clouds about, the summits of Haleakala and Mauna Kea were always visible. On the forms and movements of the clouds I made regular observations. Perhaps the most striking phenomenon was that of the evanescent cirrus. In one minute the observer may be gazing at a cloudless sky overhead. In the next there appears as if by magic a large white cloud, which, being at no great elevation, is carried rapidly across the zenith and dissolves away in the course of a few minutes. The history of one of these clouds may thus be traced. The spectator looking, we will say, to the east, sees only the clear blue of a cloudless sky. Then suddenly a tiny white speck appears and in a few minutes the speck becomes a conspicuous cloud. In less than half a minute it has attained considerable dimensions, and as it is borne rapidly westward it exhibits violent commotion in its interior, frequently changing its form and in a few minutes melting away altogether. Sometimes, when there were a number of these cirri visible, the heavens presented quite a bewildering spectacle in quick appearance and disappearance of the clouds and in their frequent change of form.

There was a continual struggle between the northerly and southerly winds on the summit, the vicinity of my tent in the middle of the west side of the crater being their frequent battle ground. At such times miniature whirlwinds carried up sand and paper into the air, and if the tent was open, its interior became filled with dust. On the north and east sides the wind was usually northeast and easterly. On the south side it was south and easterly, while on the west side north to northwest and southwest to south-southwest were the prevailing directions of the wind, but the wind was rarely strong at the camp. One morning I left my tent at 7 o'clock with a light southerly breeze blowing, but after proceeding about half a mile to the north I found myself facing a bitterly cold northeast gale, against which I could scarcely stand, so that my purpose of going around the crater had to be abandoned for that day. Returning to the tent, I met the northerly wind once more.

My descent into the crater was made on the northwest side. It was a tedious operation, and one had to tread warily on the loose bowlders, that are often inclined to roll down and crush the intruder on his way. As soon as I reached near the center of the great pit the clouds began to pour in on all sides over the lips of the crater. In a few minutes I was enveloped in a dense mist, and any further observation was rendered impracticable. During the prevailing dry, clear weather with a cloudless sky, "smoke" is only evident in two places in the crater, one near the center and the other in the southwest corner from the base of a yellowish cliff, where there are apparently extensive deposits of sulphur. When, however, the sky is clouded, and especially when the air is moist, white vapor may be seen arising from the greater part of the surface of the crater. The change is a little startling, the true explanation being that a large amount of the vapor evolved is only visible in cloudy, murky weather. It is, therefore, possible that the accounts of two observers may vary greatly as to the crater's condition, and yet no difference in the condition actually exist. This especially applies to the district on the south and southwest borders of the crater, stretching about a mile to the southward. In cloudy weather white vapor arises from many places in this area. Many of these cracks and fissures exhibit evidence of having originally given passage to vapors at a very high temperature. The red glaze that coats their sides could never have been produced by the comparatively cool vapors now discharged from them. I should judge that the subterranean heat is now more actively displayed in the district extending a mile to the south of the big crater than in the crater itself. A very large amount of vapor is discharged from the borders of a small crater lying near Pohaku Hanalei, and this is probably the smoke sometimes observed from the Kona coast. One may expect that the next eruption will occur on this, the south-southwest slope of the mountain.

Curiously enough, insects of various descriptions are common on the summit. One species of butterfly common at the coast is not at all infrequent. The butterflies were more often to be found dead than alive, and those flying about were in a half drowsy condition and easily caught. There were flies of different kinds, the house fly and the bluebottle fly proving a great nuisance in my tent. Besides these there were moths, bees, gnats and an occasional dead dragon fly, while bugs and other insects were collected as they fed upon the bodies of the dead butterflies. These insects were more common when the wind was southerly, and no doubt they had been brought up to this absolutely sterile region by the wind. Evidently most, if not all, of the butterflies and moths soon die and probably the other insects, too. The whole matter is, however, very suggestive and shows how readily insects, even the parasitical bug, may find their way into the upper air currents.

During the last few days of my stay on the summit I found myself getting sensibly weaker, which I attributed partly to want of sleep and partly to lack of appetite. The kerosene had got mixed with the biscuit on the way up, and the sugar was in the same condition. Fancy also gave the same flavor to the bacon and rice, and I swallowed my food like so much sawdust. My face was like that of a coal heaver, washing being rather risky at that altitude. On the last day, however, I made myself a little respectable and awaited the arrival of the relieving party. When, therefore, on the evening of August 30 I heard the sound of voices, and the clatter of horses' feet outside the tent, I was not long in giving the party a welcome.

* Acanthopanax sessiliflorum, Seemann in Journ. Botany, v (1867), 230; syn. Panax sessiliflorum, Ruprecht and Maximowicz, 1857, and Maximowicz, Primit. Flor. Amur. 131; Regel, Garten Flora (1862), t. 369, p. 238; Panax sessilifolium, C. Koch, Dendrob., i, 675.

A WORD TO MAIL SUBSCRIBERS.

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A new division in the middle ring of Saturn has been detected by Prof. Schaeberle. It is only partial, and is about the same width as Cassini's. Prof. Schaeberle thinks the division is not complete and that intervening matter reflects light so well that it is difficult to detect the division.

ON COMPUTING THE RADII OF AN ACHROMATIC OBJECTIVE.

By CHARLES L. WOODSIDE, Boston, Mass.

IT is not the intention of the writer in this paper to discuss the comparative values and particular merits of the various forms of achromatic objectives, but to place before the reader a simple and effective means by which the radii of the four surfaces of such an objective may be easily and correctly obtained.

When, several years ago, the writer decided to grind an achromatic of five inches aperture, he found that the determination of the proper curves was no easy task; and although the lenses might have been ground on curves similar to some others, yet the element of uncertainty in the result was so great, owing largely to the fact that nothing was known of the refractive or dispersive powers of the glass which was intended to be used, that the writer decided to investigate the subject, first theoretically, then practically, in the hope of evolving some simple method of ascertaining the proper curves under such conditions; and, while no claim is made for originality of treatment, the writer hopes that the results of his experience may be worth recording for the benefit of those who are endeavoring to obtain objectives for themselves by their own handiwork.

The formula employed in computing the radii is practically that of Littrow, and an objective constructed according to this plan will have its crown lens double convex and its flint lens double concave generally, though sometimes concavo-convex. The first two surfaces, I and II, reckoning from the front of the objective, will always be of equal radii; III will be of nearly the same radius as II, and in certain cases the radii of I, II and III may be alike, while IIII will usually be of long radius, nearly flat.

In the making of an objective, if the indices of refraction and the ratio of the dispersions of the two pieces of glass are known, the four radii and resulting focal length may be computed with reasonable exactness before the work begins; but, if these quantities are not known, they must be assumed, and the resulting focal length will therefore be uncertain within small limits until the work has reached a certain stage of completion.

Presuming, then, that these quantities are known, we have:

μ = mean index of refraction } of the crown glass.
$D\mu$ = dispersion
μ' = mean index of refraction } of the flint glass.
$D\mu'$ = dispersion
λ = ratio of the dispersions.
δ = ratio of the dispersive powers (that is, the dispersions combined with the refractions) = ratio of the focal lengths of the lenses.
I = radius of the outer surface } of the crown lens.
II = radius of the contact surface
III = radius of the contact surface } of the flint lens.
IIII = radius of the outer surface
f_1 = focal length of the crown lens.
f_2 = focal length of the flint lens.
F = focal length of the objective.

Let us first compute λ, which we use as the argument of the "Table for Computing Radius III," thus:

$$\frac{D\mu}{D\mu'} = \lambda \quad\ldots\ldots\ldots\ldots (1)$$

and then compute δ, the ratio of the dispersive powers (and consequently the ratio of f_1 to f_2, inasmuch as the focal lengths of the lenses must be proportional to the dispersive powers), thus:

$$\lambda \div \frac{\mu - 1}{\mu' - 1} = \delta \quad\ldots\ldots\ldots\ldots (2)$$

Having determined upon the focal length of the objective, we next compute f_2 thus:

$$F \times \frac{1-\delta}{\delta} = f_2 \quad\ldots\ldots\ldots\ldots (3)$$

and f_1 thus:

$$f_2 \times \delta = f_1 \quad\ldots\ldots\ldots\ldots (4)$$

We now compute the radii of I and II thus:

$$f_1 \times 2 \times (\mu - 1) = \mathrm{I} = \mathrm{II} \quad\ldots\ldots\ldots\ldots (5)$$

and then referring to the "Table for Computing Radius III" on next page, and using λ as the argument, we take out the quantities α, β and γ, and compute III thus:

$$f_1 \times \left[\alpha + \left(\beta \times (\mu - 1{\cdot}50) \right) + (\gamma \times (\mu' - 1{\cdot}60) \right] = \mathrm{III} \ldots (6)$$

It only remains for us to compute IIII thus:

$$\frac{\mathrm{III} \times \left(f_2 \times (\mu' - 1) \right)}{\mathrm{III} - \left(f_2 \times (\mu' - 1) \right)} = \mathrm{IIII} \quad\ldots\ldots\ldots\ldots (7)$$

and we have the complete data for the construction of the objective.

Let us, for example, compute the radii of an objective of 60 in. focal length, using hard crown and dense flint glass, for which we find that:

μ = 1·52
μ' = 1·63
$D\mu$ = 0·014
$D\mu'$ = 0·028

$$\lambda = \frac{0{\cdot}014}{0{\cdot}028} = 0{\cdot}5 \quad\ldots\ldots\ldots\ldots (1)$$

$$\delta = 0{\cdot}5 \div \frac{0{\cdot}52}{0{\cdot}63} = 0{\cdot}60577 \quad\ldots\ldots\ldots\ldots (2)$$

F = 60 in., and

$$f_2 = 60 \times \frac{1{\cdot} - 0{\cdot}60577}{0{\cdot}60577} = \frac{0{\cdot}39423}{0{\cdot}60577} = 39{\cdot}0474 \quad\ldots\ldots (3)$$

$$f_1 = 39{\cdot}0474 \times 0{\cdot}60577 = 23{\cdot}6537 \quad\ldots\ldots (4)$$

$$\mathrm{I\ (and\ II)} = 23{\cdot}6537 \times 2 \times 0{\cdot}52 = 24{\cdot}5998 \ldots\ldots (5)$$

From the Table, with $\lambda = 0{\cdot}5$ as the argument, we find that $\alpha = 1{\cdot}00273$, $\beta = 1{\cdot}331$ and $\gamma = 0{\cdot}623$; hence,

$$\mathrm{III} = 1{\cdot}00273 + (1{\cdot}331 \times 0{\cdot}02 = 0{\cdot}02662) + (0{\cdot}623 \times 0{\cdot}03 = 0{\cdot}01869) = 1{\cdot}04804 \times 23{\cdot}6537 = 24{\cdot}7900 \ldots\ldots (6)$$

$$\mathrm{IIII} = \frac{24{\cdot}79 \times (39{\cdot}0474 \times 0{\cdot}63)}{24{\cdot}79 - (39{\cdot}0474 \times 0{\cdot}63)} = \frac{609{\cdot}8305}{0{\cdot}1902} = 3206{\cdot}26 \ldots\ldots (7)$$

Therefore, we have—

I	24·60	in.
II	24·60	"
III	24·79	"
IIII	3206·26	"
F	60·00	"

It will at once be seen that the computation of the radii is extremely simple and direct, and requires no more knowledge of arithmetic than is commonly acquired in our public schools.

It has been stated above that in certain cases the radii of I, II and III may be made of equal length. The condition upon which this depends is that the computed radius of II (and I) must be slighter shorter than that of III. Such being the case, the radii of I and II may then be increased to equal that of III and the lenses separated a certain small distance exactly equal to the increase in focal length of the crown lens resulting from the increase in the radii of I and II. It may be remarked, however, that the distance by which the lenses are separated must not be large, and ought not in any case to exceed say one twenty-fifth of the focal length of the crown lens. It should also be noted that, although the actual focal length of the crown lens is increased, its equivalent or effective focal length remains unchanged, inasmuch as the separation reduces the power of the crown lens and thereby exactly compensates the increase of the focal length in its effect upon the chromatic and spherical aberrations; so that the value of f_1 becomes $f_1 - d$, and this expression is to be used in all cases where the lenses are separated, to represent the value of the focal length of the crown lens.

If an objective is to be constructed upon this plan, we compute the radii of the four surfaces in the usual way and then find the distance, d, by which the lenses are to be separated, thus:

$$\mathrm{I} - \frac{\mathrm{II}}{\mathrm{III}} \times f_1 = d \quad\ldots\ldots\ldots\ldots (8)$$

and then simply make the radii of I and II of the same length as III.

If we take, for instance, the previous example, we find that the radii of I and II = 24·60, while that of III = 24·79. The radii of the crown being shorter than III, the condition of separation is fulfilled and we compute the distance between the lenses, thus:

$$\mathrm{I} - \frac{24{\cdot}60}{24{\cdot}79} = 0{\cdot}00772 \times 23{\cdot}6537 = 0{\cdot}1826$$

The radii of the objective will then be—

I, II, III	24·79	inches.
IIII	3206·26	"
d	0·1826	"
F	60·00	"

By this method of treatment, we have an objective at once effective, extremely simple in form and comparatively easy to produce, inasmuch as it requires but two pairs of tools, an item of no small consequence to the amateur. It may be urged, upon theoretical grounds, that the separating of the lenses is not conducive to the very best results; and while this is undoubtedly true when the separation is quite considerable, yet if the limit already named is not exceeded, the practical advantages of the form very much more than compensate any theoretical objection. In this connection it may be stated that the Clarks have separated the lenses of all their later large productions, including the 36 in. Lick objective.

Let us presume now that the objective is to be made from two pieces of glass, of the refractive and dispersive powers of which we know nothing. It is evident, from what has already been said, that the quantities μ, μ', λ and δ must be known before the radii of the objective can be computed. We must, therefore, proceed in a manner practically the reverse of that already employed, and first form the glass into lenses from which we may deduce these quantities with great accuracy, by the aid of which we may then compute the radii of the four surfaces in the usual way and complete the objective.

In the absence of any definite knowledge of the constitution of the glass, we must assume μ and δ, and upon the correctness of these assumptions will the focal length depend to some extent.

Perhaps the best and clearest way of showing this method of procedure is by a practical example from my own experience, in the making of a 5 in. objective. The two pieces of glass for this objective were obtained at different times, and beyond the fact that they were made by Feil, nothing was known concerning their optical properties. The ratio of their dispersive powers, δ, was assumed to be 0·63, from which it was found by equation 3 that for an objective of 62½ in. focal length, f_2 should be 36·70 in.

$$62{\cdot}5 \times \frac{1{\cdot}00 - 0{\cdot}63}{0{\cdot}63} = 36{\cdot}70$$

and by equation 4 that f_1 should be 23·12.

$$36{\cdot}70 \times 0{\cdot}63 = 23{\cdot}12$$

Next, the index of refraction of the crown glass, μ, was assumed to be 1·51, and the radii, I and II, necessary to give the required focal length, f_1, were found by equation 5 to be 23·58 in.

$$23{\cdot}12 \times 2 \times 0{\cdot}51 = 23{\cdot}58.$$

As these computations were approximations only, the radii of I and II were made 23·50, and one pair of tools was prepared of that curvature. Work was then begun on the crown lens, and it was ground and polished complete, great care being exercised in keeping the surfaces as true as possible to the curve. The front surface of the flint lens, III, was then ground with the convex mate of the tool used in grinding the crown lens, and for the back surface, IIII, a tool was used of 270 in. radius (which had strayed into my possession at some previous time) and these surfaces were then polished. Had not this tool been at hand, it would have been necessary to grind IIII of the same radius as III; but, had this been done, then only a little more than one-half the diameter of the lens (say 3 in. of a 5 in.) would have been ground, as, otherwise, the lens would be made too thin at the center, because of the great curvature of the tool.

After the lenses were polished, the exact radius of curvature was obtained by the reflection of light from the surfaces of the flint lens. This was easily done by means of a tin screen, through which a large pinhole had been made, placed around a light, the rays of which, emerging from the pinhole, impinged upon the concave surface of the lens and were reflected back to an eyepiece placed near the pinhole. The best arrangement was to fix the screen and eyepiece about 4 in. apart, on a piece of board, which could then be placed upon a table and moved back and forth, farther from or near to the lens, as occasion required. It should be noted that the movement of the board should be as nearly as possible in the line of the optical axis of the lens, and that the pinhole and the thread of the eyepiece must be at equal distances from the lens at all times. The tin screen should entirely surround the lamp and be several inches taller than the lamp chimney; and the pinhole should be opposite the bright part of the lamp flame. A low power positive eyepiece should be used, with a fine silk thread placed exactly in its focus. The lens was now focused carefully until a good clear image of the pinhole was obtained, and the distance was then measured from the surface of the lens to the thread of the eyepiece (or the pinhole), which distance represented the actual radius of that surface of the lens.

The radius of III was found to be entirely correct, being 23·50 in.; but that of IIII was slightly longer than the radius of the tool and measured 278 in.

The radii of I and II cannot be obtained in this manner, but as I, II and III were all ground on the same pair of tools, it was safe to assume that all were of the same radius.

The glass had now been formed into lenses of known radii and from them was to be ascertained, by actual trial, their true focal lengths and their optical properties.

The crown lens was then mounted in a tube, and in front of the lens was placed a diaphragm which cut off all the rays of light except a ring or zone about one-quarter inch wide, midway between the center and edge of the lens. The eyepiece with the thread in its focus was used, and the whole carefully focused on a bright star. The focal length was then measured from the middle of the edge of the lens to the thread of the eyepiece, parallel to the optical axis of the lens, and the mean of several trials was 22·82 in. The quantities, I, II and f_1 now being known, μ was found by the following equation to be 1·51489.

$$1 + \frac{\mathrm{I} \times \mathrm{II}}{(\mathrm{I} + \mathrm{II}) \times f_1} = \mu \quad\ldots\ldots\ldots\ldots (9)$$

$$1 + \frac{23{\cdot}5 \times 23{\cdot}5}{(23{\cdot}5 + 23{\cdot}5) \times 22{\cdot}82} = 1{\cdot}51489$$

The lenses were now mounted together, the surfaces, II and III, being in contact with each other. The focal length, F, of the combined lenses was then measured as before from the same points, and found to be 66·82 in. Then, by the following equation the focal length of the flint lens, f_2, was found to be 34·655 in., thus:

$$\frac{F \times f_1}{F - f_1} = f_2 \quad\ldots\ldots\ldots\ldots (10)$$

$$\frac{66{\cdot}82 \times 22{\cdot}82}{66{\cdot}82 - 22{\cdot}82} = 34{\cdot}655$$

and by the following equation μ' was found to be 1·62526.

$$1 + \frac{\mathrm{III} \times \mathrm{IIII}}{(\mathrm{III} + \mathrm{IIII}) \times f_2} = \mu' \quad\ldots\ldots\ldots\ldots (11)$$

$$1 + \frac{23{\cdot}5 \times 278{\cdot}}{(23{\cdot}5 + 278{\cdot}) \times 34{\cdot}655} = 1{\cdot}62526$$

The lenses were again mounted in the tube, without the diaphragm, and gradually separated until the color correction was the very best that could be obtained. Great care was exercised in this test, and several different objects were tried—the moon, Jupiter, Saturn, thermometer bulbs in sunshine, etc.—and the separation of the lenses was best effected by means of paper and cardboard rings placed between them. The distance between the lenses was then measured carefully, the mean of several trials being 0·719 in. This showed that the focal length of the crown lens was too long by just the amount of separation required—that is, if f_1 had been 22·101 in., the objective would then have been achromatic when the lenses were in contact. From these quantities, then, $f_1 - d$ and f_2, the ratio of the dispersive powers, δ, was found by the following equation to be 0·63774, thus:

$$\frac{f_1 - d}{f_2} = \delta \quad\ldots\ldots\ldots\ldots (12)$$

$$\frac{22{\cdot}82 - 0{\cdot}719}{34{\cdot}655} = 0{\cdot}63774$$

But while, for the purpose of obtaining the ratio of the dispersive powers of the lenses, the focal length of the crown was considered as too long by 0·719 in., on the other hand, the focal length of the crown may be considered as correct and the focal length of the flint as too short by a proportionate amount; and this latter view is the one which will be adopted in the further consideration of the subject.

The reason for this will at once be plain; for while to shorten the focal length of the crown lens involves the regrinding and polishing of two surfaces, the lengthening of the flint lens involves one surface only, that of IIII. It will be evident, too, that the crown lens, being equiconvex, will always be correct in form, and with the lengthening of the flint focus by the increase

TABLE FOR FINDING RADIUS III.

λ	α	β	γ	λ	α	β	γ
·500	1·00273	1·331	·623	·602	1·01050	1·474	·554
·502	1·00300	1·337	·621	·604	1·01047	1·477	·554
·504	1·00327	1·344	·620	·606	1·01045	1·480	·553
·506	1·00354	1·349	·618	·608	1·01042	1·483	·552
·508	1·00381	1·355	·616	·610	1·01038	1·486	·552
·510	1·00408	1·360	·615	·612	1·01034	1·489	·551
·512	1·00434	1·365	·613	·614	1·01029	1·492	·550
·514	1·00461	1·369	·612	·616	1·01024	1·495	·550
·516	1·00487	1·374	·611	·618	1·01018	1·498	·549
·518	1·00512	1·377	·609	·620	1·01013	1·501	·549
·520	1·00538	1·381	·608	·622	1·01007	1·503	·549
·522	1·00563	1·384	·606	·624	1·01000	1·506	·548
·524	1·00588	1·387	·604	·626	1·00994	1·509	·548
·526	1·00612	1·391	·603	·628	1·00987	1·512	·547
·528	1·00636	1·393	·602	·630	1·00980	1·515	·547
·530	1·00659	1·396	·601	·632	1·00974	1·517	·547
·532	1·00682	1·399	·599	·634	1·00966	1·520	·546
·534	1·00705	1·401	·598	·636	1·00959	1·523	·546
·536	1·00727	1·403	·596	·638	1·00952	1·525	·545
·538	1·00748	1·406	·595	·640	1·00945	1·528	·545
·540	1·00768	1·408	·594	·642	1·00938	1·530	·545
·542	1·00788	1·410	·592	·644	1·00931	1·532	·545
·544	1·00808	1·413	·591	·646	1·00925	1·534	·544
·546	1·00826	1·415	·589	·648	1·00919	1·536	·543
·548	1·00844	1·417	·588	·650	1·00912	1·538	·543
·550	1·00861	1·419	·587	·652	1·00906	1·540	·543
·552	1·00878	1·420	·585	·654	1·00902	1·541	·543
·554	1·00894	1·422	·582	·656	1·00897	1·542	·542
·556	1·00909	1·424	·581	·658	1·00893	1·543	·542
·558	1·00923	1·425	·580	·660	1·00890	1·544	·541
·560	1·00937	1·428	·579	·662	1·00887	1·544	·541
·562	1·00960	1·430	·577	·664	1·00886	1·545	·541
·564	1·00962	1·432	·576	·666	1·00884	1·544	·540
.566	1·00973	1·433	·574	·668	1·00884	1·544	·540
·568	1·00984	1·435	·573	·670	1·00885	1·544	·540
·570	1·00994	1·437	·572	·672	1·00887	1·542	·541
·572	1·01003	1·439	·570	·674	1·00890	1·541	·541
·574	1·01011	1·441	·569	·676	1·00894	1·539	·541
·576	1·01018	1·443	·567	·678	1·00899	1·537	·541
·578	1·01025	1·445	·566	·680	1·00906	1·534	·541
·580	1·01031	1·448	·566	·682	1·00914	1·531	·541
·582	1·01036	1·450	·564	·684	1·00924	1·527	·542
·584	1·01041	1·452	·563	·686	1·00935	1·523	·542
·586	1·01044	1·454	·561	·688	1·00947	1·519	·543
·588	1·01047	1·456	·561	·690	1·00962	1·513	·543
·590	1·01050	1·459	·560	·692	1·00978	1·507	·543
·592	1·01051	1·462	·559	·694	1·00997	1·500	·544
·594	1·01052	1·464	·558	·696	1·01017	1·494	·544
·596	1·01053	1·466	·557	·698	1·01039	1·487	·545
·598	1·01052	1·469	·556	·700	1·01063	1·480	·545
·600	1·01051	1·472	·555				

EXPLANATION.—The table is computed for a refractive index of 1·50 for the crown glass and 1·60 for the flint glass.
λ represents the ratio of the dispersions of the two lenses.
α represents the radius of the third surface (III), the unit of measure being 1.
β represents the factor to be multiplied by the variation of the crown index from 1·50.
γ represents the factor to be multiplied by the variation of the flint index from 1·60.
α, β and γ are then to be added together and their sum multiplied by the focal length (f_1) of the crown lens; the result will be radius III.

of radius, IIII, will be correct in focal length also; and the proper separation of the lenses, while effecting the color correction, at the same time brings the surfaces, II and III, into their proper relation with each other to correct the spherical aberration.

The optical properties of lenses were now all known quantities, and it remained to compute the distance, d, by which the lenses were to be separated, the focal length of the flint lens in order that it may be proportional to the ratio of the dispersive powers, δ, and the radius of IIII to produce this focal length.

First, then by Eq. 1, λ was found to be 0·52517, thus:

$$0·63774 \times \frac{0·51489}{0·62526} = 0·52517$$

and with this as the argument the quantities α (1·00601) β (1·389) and γ (0·6035) were taken from the table and the distance between the lenses, d, was found by the following equation to be 0·2696 in., thus:

$$f_1 - \frac{\mathrm{II}}{[\alpha + (\beta \times \mu - 1·50) + (\gamma \times \mu^1 - 1·60)]} = d \;..\; (13)$$

thus:

$$22·82 - \frac{23·5}{1·00601 + 0·02083 + 0·01527} = 0·2696.$$

Then, by this equation, f_2 was found to be 35·3598 in., thus:

$$\frac{f_1 - d}{\delta} = f_2 \ldots\ldots\ldots\ldots\ldots\ldots (14)$$

$$\frac{22·82 - 0·2696}{0·63774} = 35·3598$$

and by Eq. 7, IIII was found to be 373·52, thus:

$$\frac{23·5 \times (35·3598 \times 0·62526)}{23·5 - (35·3598 \times 0·62526)} = 373·52$$

while the focal length of the objective, F, was found to be 62·249, thus:

$$\frac{f_2 \times (f_1 - d)}{f_2 - (f_1 - d)} = F \ldots\ldots\ldots\ldots\ldots\ldots (15)$$

$$\frac{35·3598 \times 22·5504}{35·3598 - 22·5504} = 62·249.$$

Therefore, we have:

I, II, III	23·50	in.
IIII.	373·52	"
f_1	22·82	"
f_2	35·3598	"
F	62·2490	"
d	0·2696	"
μ	1·51489	"
μ'	1·62526	"
δ	0·63774	"

The back surface of the flint lens IIII was then reground and polished, figuring of any kind having been carefully avoided, the object being to keep the surfaces as nearly as possible to the computed curves; after which the objective was tested and proved even at this stage of completion to be very nearly correct. The objective was then finished by figuring where necessary, and has since proved to be most satisfactory in its performance.

METHODS OF DETERMINING THE ECONOMIC PRODUCTIVITY OF MUNICIPAL ENTERPRISES.*

THIS topic must be defined and limited before it can be profitably discussed. Obviously, it does not cover all municipal enterprises. No practical object would be gained by a discussion of the economic productivity of roads or parks or sewers or police. It is needless to justify what everyone accepts. On the other hand, there are classes of municipal enterprises the economic productivity of which is a matter of controversy. Means of transportation within the municipality or public docks may serve as examples. If a municipal enterprise aims primarily at rendering an economic service, it may fairly be tested by its economic productivity, but otherwise not. Certain municipal enterprises are merely or mainly devices for rendering economic services cheaply and well. Their efficiency must be determined by comparing them with other devices for rendering equivalent services. The latter may be divided into private enterprises regulated mainly by competition and private enterprises regulated both by competition and by governmental interference. This leads to a final limitation of the question, viz., the methods of comparing the economic productivity of municipal enterprises aiming at economic production with private enterprises rendering similar services and more or less subject to governmental control. It may be noticed in passing that the final decision upon the wisdom or folly of such municipal enterprises must be influenced by many considerations besides the economic productivity of the ventures. The general theory of our law and political science is adverse to a wide extension of the functions of municipalities in such directions. The not infrequent corruption and the more frequent incompetency of our city governments are practical arguments in favor of the same position. On the contrary, the high-handed procedure of many corporations holding public franchises, an argument entirely aside from the present phase of the subject, is yet of great, perhaps of decisive, weight in forming the final conclusion.

The economic productivity of municipal enterprises may be measured only by comparing their efficiency with that of similar private enterprises. But the two have diverse ends in view. The aim of a municipal enterprise is to satisfy the voters; the aim of a private plant is to earn money for the corporation. Hence they are not likely to render the same service, except occasionally and by accident. To be sure, one most important means of pleasing the voters is by convincing them that their money is being saved and their taxes reduced. But perhaps as many voters would be influenced by a policy of generous or lavish display as by a favorable balance sheet. So, too, a most important means of earning money for a corporation is by pleasing not necessarily all the voters, but the patrons and possible patrons.

The fact remains, however, that the primary object in the two cases is different and that we cannot compare the economics of the two systems until one or the other of these ends or some intermediate one is made our standard. Perhaps we may say that the primary end is to protect the capital invested, whether private or public, and, if it be private, to secure a reasonable return upon what has been necessarily and legitimately expended, and that the further end is to render a satisfactory service to the consumers, who may often be substantially the entire public. If this be admitted, it follows that the true end is not that of the ordinary corporation or of the ordinary municipal enterprise, and that the former is likely to neglect the interests of the consumers and the latter to risk the capital of the taxpayers. Furthermore, the consumers may be grouped into two classes, the municipality as a body and the private citizens as individuals, and the balance must be held between these two interests, which are often antagonistic. It is not, I believe, uncommon for a private corporation seeking a contract or franchise to offer unduly favorable terms to the muncipality and recoup itself for losses thus incurred by unduly high prices to individual patrons. Municipal enterprises, on the contrary, are tempted to close contracts with private patrons at a losing figure and let the municipality as a whole make up the losses.

The arguments upon the profitableness of municipal ownership differ so widely in the various enterprises that a statistical examination must lose in thoroughness and range if it seeks to include several classes under a single investigation. From the point of view of method, therefore, it would seem better to make a separate statistical study for each industry affording the requisite information. For this purpose gas lighting has been chosen as the one upon which the greatest amount of trustworthy information is available. The facts regarding the gas companies of Massachusetts have been gathered now for ten years, and evidence of certain changes may be derived from a collation of the facts contained in the eleven annual reports of the board of gas and electric light commissioners of that State. I may briefly recapitulate the changes which by way of extended illustration have been shown to have occurred, and presumably to be still progressing in Massachusetts, and not improbably elsewhere under the system of private control subject to state supervision.

(1) The manufacture of coal gas increased five-sixths in nine years.

(2) The proportion of this gas unaccounted for, and so attributable to leakage, has fallen to about three-fifths of what it was eight years ago.

(3) The quality of the gas has improved, especially in the case of the larger companies.

(4) The number of high power gas lamps and of gas stoves has been rapidly increasing.

(5) Meanwhile the number of public gas lights has fallen about two-fifths.

(6) The price of gas has been falling, especially among the larger companies.

(7) The proportion of the cost of coal obtained from the sale of residuals has been rising.

Now the point upon which emphasis is to be laid is that the changes to which every sort of enterprise is subject, and of which the foregoing are illustrations, are of far greater importance in the determination of its real economic productivity than the condition of that business at any point of time. Assume for the moment that all these gas companies had been managed for the last decade as municipal enterprises, would the same changes have taken place? If not, would those that did occur have resulted in a greater or in a less economic productivity? Such questions, it appears to me, are speculative and will be answered by every one in accordance with preconceived ideas or theoretical arguments. I see no way in which to wring a conclusive answer to them from experience. Accordingly the answer which as a statistician rather than a theorist I am compelled to make to the question at issue is, in the first place, that until municipal enterprises have had a longer history, and the facts have been gathered and presented in a shape suitable for comparison, no method of determining their economic productivity will give convincing results, and that, secondly, when the facts are obtainable, the conclusions must be drawn from the changes which are fostered by the various systems, and that the conditions prevailing under any one at a particular time must be deemed of subsidiary importance.

* Prof. Walter F. Wilcox, of Cornell University, in the American Journal of Sociology, Chicago, November. Condensed for Public Opinion.

A PROFITABLE SPECIALTY—THE MANUFACTURE AND SALE OF FURNITURE POLISH.

LEON L. WALTERS points out (American Druggist) the fact that there are many widely used preparations the manufacture of which comes directly within the province of the pharmacist, and which, if properly pursued, become sources of very considerable trade and profit, and which tend greatly to offset the loss of trade in toilet articles, stationery and the like resulting from the fierce, and in many instances unfair, competition of department and other stores.

Prominent among the means that are open to almost every druggist as a profitable addition to his business is the making and selling of

FURNITURE POLISHES AND CREAMS.

The amount of these preparations used annually is very considerable, and with a little effort there is no reason why the druggist should not be able to command at least a portion of this trade.

The polishes most generally sold vary widely in their composition and utility, and it is difficult to devise a formula for any one polish to give uniform satisfaction. Formulas are, therefore, given for a number of polishes and creams, any one of which produces a tolerably good article.

Perhaps the most widely known and generally used

of furniture polishes is the one commonly designated as

"CHEMICAL POLISH."

	Parts.
Linseed oil	40
Alcohol	4
Vinegar	16
Antimony chloride	2
Ammonium chloride	1
Spirits of camphor	1

Place the oil in a large bottle, and add successively the antimony chloride, the spirits of camphor, the vinegar and the alcohol, part by part, and with constant shaking; when thoroughly incorporated, add the sal ammoniac.

This, perhaps, as an "all round" polish gives better satisfaction than any other. The following simpler formula has, however, during a trial of some four years proved very satisfactory. It is sometimes sold as

ACME FURNITURE POLISH.

Boiled linseed oil	4	pints.
Alcohol	2	"
Turpentine	1½	"
Antimony terchloride solution	10	drachms.

Mix the linseed oil and the turpentine; dissolve the antimony terchloride in the alcohol, and add to the oil and turpentine little by little, shaking after each addition.

As a fair sample of polishes containing acids, the following may be taken:

ACID POLISH.

Boiled linseed oil	4 ounces.
Alcohol	5 "
Hydrochloric acid	2 drachms.
Red sanders, q. s. to color.	

Mix the oil with the alcohol; then add the acid with constant shaking.

As a renovating polish, the above is widely used. It should be shaken up before being used.

Pastes and creams, on account of their cleanliness and ease of application, are coming to be quite generally used. The formula given below produces an article that will compare more than favorably with any now on the market:

FURNITURE CREAM.

White soap	2½	ounces.
Spirits turpentine	80	"
White wax	20	"
Water	110	"
Carbonate potash	1	"

Place the soap in a water bath with a portion of the water and melt by a gentle heat, adding the remaining water as fast as absorbed. Now add the wax and increase the heat until it melts. Reduce the heat and add the turpentine gradually, stirring until all is thoroughly incorporated.

This produces an elegant article, which sells rapidly and gives even satisfaction. It should be put up in one and a half and two ounce ointment jars properly labeled.

THE SELLING OF THEM.

Two fields are open for the sale of the above: First, at retail to local trade and, second, in quantities to furniture dealers. For local trade there are two seasons in which special effort should be made to push the sale of the above, namely, during spring and fall house cleanings. At these times the judicious use of window displays, combined with appropriate, neat and striking signs, will be of great service. But of all the means at hand for calling your customers' attention to the fact that you make such preparations, perhaps the most efficient consists in the printing of a brief little folder with reference to furniture polishes alone. Such a folder, of say four pages (two double pages), costs but comparatively little, and, if properly composed, the results fully merit the outlay. Make it brief and concise, stating clearly and succinctly the good points of your polish, directions for its use, with a little explanation as to just why the druggist, above all others, is best fitted to know what constitutes a good furniture polish, and why he is eminently qualified to make it. During the seasons mentioned an admirable plan for distributing the folders is to inclose one in each package as it is made up. When thus carried out this method, combined with a judicious personal recommendation to customers while in the store, will seldom fail of the desired end.

The supplying of dealers with polishes of various kinds opens up a new field to many druggists. Every furniture dealer uses yearly a considerable quantity of furniture polishes and creams, which, as a rule, he buys from his wholesale dealer in bulk. I know of one druggist who derived a considerable revenue from supplying polishes to the furniture trade of his town, and there is no reason why others should not be equally as successful. Make up a small quantity of each of the different polishes for which formulas are given and send a sample of each to the furniture dealers of your city, accompanied by a circular telling of the advantages to be derived from purchasing his polishes from you, with an offer of putting them up to suit his trade. Such a letter, if properly worded and accompanied by the samples mentioned, seldom fails of a favorable reply. The manufacture of the polish need not detract in the slightest degree from the usual business of the druggist. The preparations can be made at leisure, and, what is more, they serve as a vehicle for the employment of discarded alcohol, such as has been used in the cleaning of mortars and the like, and which otherwise is of little value.

The charges upon cotton in New Orleans for storage and compressing are the same as those governing the trade last year, says the Textile World. We select the following charges, as they will be of interest to some of our readers: Storage for first thirty days on compressed cotton, 15 cents; extra charge for every additional thirty days, or part thereof, 8 cents; compressing, per bale, 50 cents; compressing and draying to and from press, per bale, 60 cents; turning over cotton for marking, per bale, 3 cents; extra bands, 5 cents each; sample hole covering, per bale, 2 cents; sewing up heads, per bale, 3 cents.

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